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ABSTRACT

This publication aims to assist educators and policymakers in examining regional trends in science and mathematics education. Recent data on key factors influencing mathematics and science education is presented. Key factors include population growth and diversity, student participation and achievement, and teacher characteristics and certification. The data and analyses were drawn from reports produced by the Northwest Regional Educational Laboratory (NWREL), U.S. government agencies, state departments of education, and professional associations. (Contains 30 references.) (ASK)

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# Depiction of Science and Mathematics Education in the Northwest

## 1998



September 1998

Northwest Regional Educational Laboratory
Mathematics and Science Education Center



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# PREFACE

The Northwest Regional Educational Laboratory's Mathematics and Science Education Center produced this publication, the *Depiction of Science and Mathematics Education in the Northwest: 1998*, to assist educators and policymakers in examining regional trends in science and mathematics education. The publication presents recent data on key factors influencing mathematics and science education: population growth and diversity; student participation and achievement; and teacher characteristics and certification. The data and analyses were drawn from reports produced by NWREL, U.S. government agencies, state departments of education, and professional associations.

Various issues, ideas, and challenges emerge from these data. Perhaps two of the most significant trends in the Northwest are the continued increase in student enrollments and the growing proportion of students who are from diverse ethnic and cultural backgrounds. The U.S. Census Bureau expects that the minority population of school-age children in this region will grow by nearly 30 percent between 1995 and 2005.

Meeting the needs of a growing and diversifying student population while implementing a system of higher academic standards for K-12 education poses additional challenges for science and mathematics education. Districts are revising curriculum to accommodate new courses that will provide students with the necessary knowledge and skills to meet the higher expectations. New assessments require students not only to demonstrate the acquisition of knowledge, but the ability to reason, problem solve, communicate, and apply knowledge. Teachers are being asked to teach in ways very different from how they were taught and prepared.

In light of these changes, teacher preparation in mathematics and science is of increasing interest. Research suggests a direct correlation between the number of mathematics and science courses taken by teachers and their students' level of achievement. The practice of assigning teachers in areas outside of their field of expertise deserves thoughtful review and consideration. Also, because a large number of teachers are expected to retire during a time of increasing enrollment, there is a projected demand for over 35,000 new teachers in the Northwest by 2005. Teacher preparation and recruitment will undoubtedly be pressing issues in the coming years.

The Center offers this statistical overview of key issues in mathematics and science education to assist educators in making informed decisions about Northwest policy and practice. However, we do so with the recognition that the power of this set of data to represent a complete picture is limited. In an effort to provide recent data, information was obtained from numerous sources whose data-collecting processes may differ. Therefore, caution should be taken when drawing comparisons between different sets of data. Nevertheless, when combined with other sources of information, it is our hope that the *Depiction: 1998* will serve to clarify needs and identify emerging issues while promoting a continuing dialogue among stakeholders on how to provide a high-quality mathematics and science education for all students.

Kit Peixotto
Director, Mathematics and Science Education Center

# DEMOGRAPHIC HIGHLIGHTS OF THE NORTHWEST

## Population

A region of contrasts, the Northwest is known both for large, sparsely populated areas, and for densely populated urban areas. More than 11.4 million people live in the region, a population that increased about 5 percent between 1993 and 1996. This growing population is unevenly distributed among the five states—Alaska, Idaho, Montana, Oregon, and Washington. Although the region encompasses more than 27 percent of the nation's land mass, it is home to only 4 percent of its people and 4.5 percent of its students. Table 1 reflects this dichotomy in population distribution in the region. The greatest population resides in Washington, the region's smallest state geographically. Conversely, the smallest population inhabits the largest state, Alaska (Northwest Regional Educational Laboratory [NWREL], 1997).

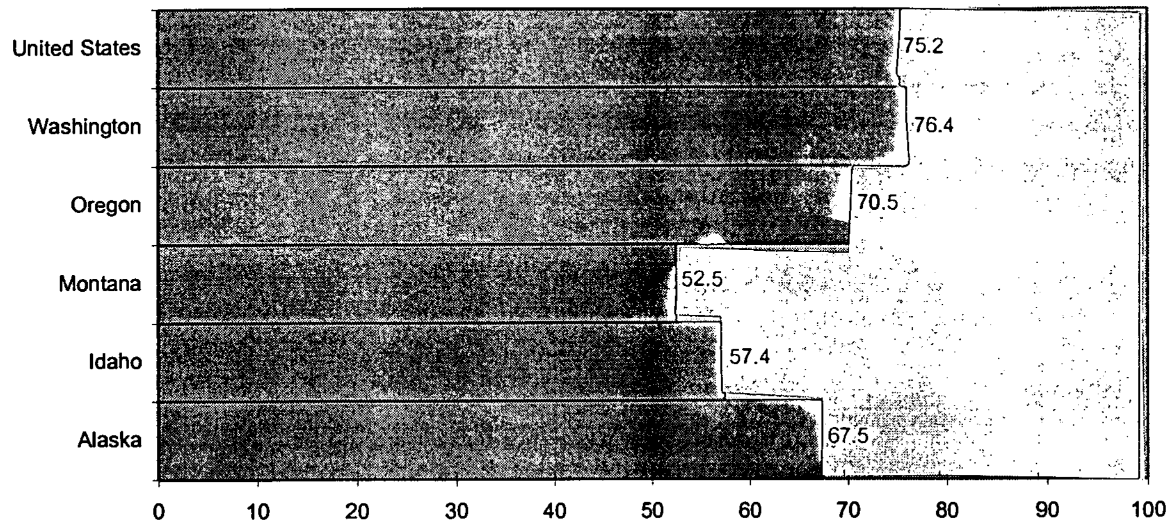
**Table 1**
Population and Density

| | 1993 population | 1996 population | Percent of change in population growth 1993-1996 | 1996 population per square mile | Population projection for 2005 |
|---|---|---|---|---|---|
| Alaska | 598,000 | 607,000 | 1.5 | 1.1 | 700,000 |
| Idaho | 1,102,000 | 1,189,000 | 7.3 | 14.4 | 1,480,000 |
| Montana | 841,000 | 879,000 | 4.3 | 6.0 | 1,006,000 |
| Oregon | 3,040,000 | 3,204,000 | 5.2 | 33.4 | 3,613,000 |
| Washington | 5,260,000 | 5,533,000 | 4.9 | 83.1 | 6,258,000 |
| Northwest | 10,841,000 | 11,412,000 | 5.0 | 11.26 | 13,057,000 |
| United States | 257,795,000 | 265,284,000 | 2.8 | 75.0 | 285,981,000 |

Source: Population data from Table 26; density data from Table 27; and population projection from Table 35 Series A, *Statistical Abstract of the United States 1997*, Bureau of the Census.

In the Northwest region, the greatest concentration of people live along the so-called "I-5 corridor," delineated by the interstate freeway between the Seattle/Tacoma metropolitan area in Washington and the Eugene vicinity in Oregon. Although all but one of the Northwest states have low population density, residents tend to be concentrated in urban areas. Alaska, Oregon, and Washington have the highest percentage of people living in urban areas. The populations of Idaho and Montana are more evenly distributed between urban and rural areas. This diversity of population density impacts schools and the general character of school communities. Tax base issues and isolation are examples of conditions partially driven by population density (NWREL, 1997).

**Figure 1**
Percent of Residents Living in Urban Communities, 1990




**Source**: Table 44, Statistical Abstract of the United States 1997, Bureau of the Census.

## Student Enrollment

The urban or rural character of schools influences the nature of the school community and the type and amount of resources available to support education. Compared to the more densely populated states in the East and Midwest, students in the Northwest tend to be concentrated at the two extremes of the urban-rural continuum. The majority of Northwest schools and school districts are small and are located in small towns or rural settings, while the majority of students tend to be concentrated in the large metropolitan schools and districts. This is especially true in Oregon, where 66 percent of students attend metropolitan schools, and in Washington, where 62 percent of all students attend these schools. In contrast, 70 percent of Montana's students, 60 percent of Alaska's students, and 59 percent of Idaho's students are concentrated in small-town and rural schools (NWREL, 1997).

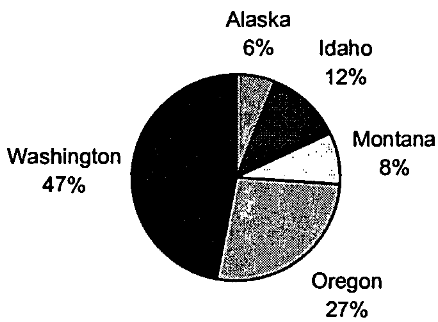
**Table 2**
Percent distribution of students by locale, 1994

| Local | Alaska | Idaho | Montana | Oregon | Washington | Total Enrollment |
|---|---|---|---|---|---|---|
| Metro-urban | 31 | 13 | 19 | 24 | 29 | 25 |
| Metro-suburban | 9 | 11 | 2 | 42 | 33 | 29 |
| Large town | 0 | 17 | 10 | 3 | 2 | 4 |
| Small town | 34 | 33 | 34 | 23 | 20 | 24 |
| Rural | 26 | 26 | 36 | 8 | 17 | 18 |

**Source**: The Nonfiscal Surveys of the Common Core of Data 1994, NCES, U.S. Department of Education

The Northwest's population growth through the 1990s is reflected in its public school enrollment. Enrollment in kindergarten through 12th grade has increased in all five states. Almost 250,000 new students were added between 1990 and 1996. This is an increase of 14 percent, compared to a 10 percent increase for the nation (National Center for Education Statistics [NCES], 1996). Growth in enrollment is expected to continue, but not evenly throughout the region. The National Center for Education Statistics estimates enrollment growth for the years 1994 to 2000 will be: Alaska, 14.2 percent; Washington, 14 percent; Oregon, 10.3 percent; Idaho, 5.6 percent; and Montana, 1.4 percent.

**Figure 2**
State Enrollment as Percent of Regional Enrollment




Source: Digest of Education Statistics, 1996

**Table 3**
Student Enrollment, Teachers, Schools, Districts

| | Student enrollment | Percent increase in student enrollment 1991-96[7] | Teachers | Students per teacher | Schools | School districts |
|---|---|---|---|---|---|---|
| Alaska[1] | 126,465 | 10 | 7,267 | 17:1 | 492 | 53 |
| Idaho[2] | 245,252 | 10 | 12,780 | 18:1 | 608 | 113 |
| Montana[3] | 164,627 | 8 | 10,253 | 16:1 | 899 | 355 |
| Oregon[4] | 537,854 | 12 | 26,757 | 20:1 | 1,213 | 199 |
| Washington[5] | 951,696 | 13 | 45,345 | 21:1 | 2,064 | 296 |
| NW Region | 2,025,894 | 12 | 102,543 | n/a | 5,276 | 1,016 |
| United States[6] | 44,840,481 | 8 | 2,598,220 | n/a | n/a | n/a |

**Sources:**

[1] Alaska enrollment and teacher data from *Facts & Figures About Education in Alaska, 1996-97*, Alaska Department of Education. Number of schools and school districts from *Alaska Education Directory, 1997-98*.

[2] Idaho enrollment and school district data from *Idaho Educational Directory: 1997-98*. Data on number of teachers and schools from *Northwest Trends Shaping Education: The 1997 Regional Education Needs Assessment*, Northwest Regional Educational Laboratory (NWREL).

[3] Montana enrollment, teachers, and school district data from *Facts About Montana Education: 1997*, Montana Office of Public Instruction. Number of schools from *Northwest Trends Shaping Education: The 1997 Regional Education Needs Assessment*, NWREL.

[4] Oregon data on enrollment, teachers, and school districts from *Oregon Report Card: 1996-97*, Oregon Department of Education. Number of schools from *Northwest Trends Shaping Education: The 1997 Regional Education Needs Assessment*, NWREL.

[5] Washington data on enrollment, teachers, schools, and school districts from *Northwest Trends Shaping Education: The 1997 Regional Education Needs Assessment*, NWREL.

[6] Data on enrollment for the United States from *Digest of Education Statistics, 1997*, Table 66; and teacher numbers from Table 65.

[7] Data for all states on percent increase in student enrollment from *Northwest Trends Shaping Education: The 1997 Regional Education Needs Assessment*, NWREL.

## Ethnic Diversity of Students

The Northwest minority population is made up of many different racial and ethnic groups, which are unevenly distributed in the region. In 1994, minority students made up 34 percent in Alaska, 20.3 percent in Washington, 13.6 percent in Montana, 13.7 percent in Oregon, and 9.4 percent of the school population in Idaho. Native Americans and Alaska Natives were the dominant minority group in Alaska and Montana, whereas Hispanics were the largest minority group in the remaining three states, as well as in the region.

**Table 4**
Ethnic Diversity of Public School Students

| | School year | Enrollment | Percent of Student Population: African American | Asian | Hispanic | Native American/ Alaska Native | Total minority | White |
|---|---|---|---|---|---|---|---|---|
| Alaska[1] | 1994 | 127,130 | 4.2 | 3.7 | 2.3 | 23.9 | 34.0 | 66.0 |
| | 1997 | 126,465 | 5.0 | 5.0 | 3.0 | 25.0 | 38.0 | 62.0 |
| Idaho[2] | 1994 | 218,179 | 0.4 | 0.8 | 7.2 | 1.0 | 9.4 | 90.6 |
| | 1998 | 245,252 | — | — | — | — | — | — |
| Montana[3] | 1994 | 175,611 | 0.4 | 0.8 | 1.1 | 11.2 | 13.6 | 86.5 |
| | 1996 | 165,547 | 0.5 | 0.8 | 1.4 | 9.8 | 12.5 | 87.5 |
| Oregon[4] | 1994 | 478,877 | 2.6 | 2.8 | 5.3 | 2.4 | 13.7 | 86.3 |
| | 1997 | 537,854 | 2.6 | 3.4 | 7.4 | 2.0 | 15.4 | 84.4 |
| Washington[5] | 1994 | 913,048 | 4.2 | 6.5 | 7.0 | 2.6 | 20.3 | 79.7 |
| | 1995 | 951,696 | 4.7 | 6.4 | 7.8 | 2.6 | 21.7 | 78.3 |
| NW Region | 1994 | 1,912,845 | 3.0 | 4.1 | 5.9 | 4.4 | 17.4 | 82.5 |
| United States | 1994 | 41,621,660 | 16.3 | 3.4 | 11.9 | 1.1 | 32.7 | 67.3 |

**Sources:**
[1]Alaska 1994 enrollment and ethnicity data from *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results*, Tables A.1 and 1.5, U.S. Department of Education. 1997 enrollment and ethnicity data from *Report Card to the Public: School Year 1996-97*, Alaska Department of Education.
[2]Idaho 1994 enrollment and ethnicity data from *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results*, Tables A.1 and 1.5, U.S. Department of Education. 1998 enrollment data from *Idaho Education Directory: 1997-98*, Idaho Department of Education.
[3]Montana 1994 enrollment and ethnicity data from *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results*, Tables A.1 and 1.5, U.S. Department of Education. 1996 enrollment data from *Facts About Montana Education: 1997*, Montana Office of Public Instruction. 1996 ethnicity data from *State Indicators of Science and Mathematics Education: 1997*, Council of Chief State School Officers.
[4]Oregon 1994 enrollment and ethnicity data from *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results*, Tables A.1 and 1.5, U.S. Department of Education. 1997 enrollment and ethnicity data from *1996-97 Oregon Report Card*, Oregon Department of Education.
[5]Washington enrollment and ethnicity data from *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results*, Tables A.1 and 1.5, U.S. Department of Education. 1995 enrollment data from *Northwest Trends Shaping Education: The 1997 Regional Education Needs Assessment*, Northwest Regional Educational Laboratory. 1995 ethnicity data from *State Indicators of Science and Mathematics Education: 1997*, Council of Chief State School Officers.
— Data not available.

By 1994, about one of every three public school students in the country belonged to a minority group. In the Northwest, this ratio was lower, about one out of five. However, minority enrollment is increasing at a faster pace than nonminority enrollment. Schools in the region are finding it increasingly necessary to respond to the diverse needs of students whose cultures and primary languages vary significantly (NWREL, 1997).

Some of the Northwest states are undergoing a more rapid change in ethnic makeup than others. Alaska has the highest percentage of minority enrollment in public schools (38 percent in 1997), but this percentage has not changed much since the mid-1980s. From 1986 to 1994, Montana had the highest rate of increase, going from 7.3 percent minority to 13.6 percent, which is nearly a two-fold increase. (Though it appears from Table 4 that minority enrollment in Montana dropped between 1994 and 1996—going from 13.6 percent to 12.5 percent—caution should be made in interpreting these data. In an effort to provide the most current data available, multiple sources were consulted, and the data-collecting processes may vary between sources.)

Between 1986 and 1994, minority enrollments in Washington increased from 15.5 percent to 20.3 percent; in Oregon from 10.2 percent to 13.7 percent; and in Idaho from 7.4 to 9.4 percent. For the United States, the percent of minority enrollment grew from 29.6 percent to 32.7 percent. Based on census estimates of growth in the minority population of five- to 17-year-olds, the Northwest region can anticipate an increase in minority enrollment from approximately 360,000 students in 1995 to 505,000 by the year 2005 (NWREL, 1997).

## School Funding

With the exception of Alaska, public schools in the Northwest are funded through a combination of local and state tax resources. The number of resources available locally to schools is determined by the value of property within the taxing jurisdiction, and the willingness of local citizens to vote in support of tax levies for schools. State governments have a range of funding options to support education, and alternatives to property tax resources have become increasingly important as local property tax limitations occur. Income tax and natural resource excise tax have been the two state taxes most commonly used for education. States are pursuing other sources such as trust funds and lottery proceeds (NWREL, 1997).

The various funding alternatives have advantages and disadvantages. States that rely heavily on income taxes for education can comfortably fund schools when the economy is strong, but struggle when the economy is poor and tax revenues are down. States that use excise taxes to support education also experience boom or bust cycles in school funding. For example, Alaska has historically relied upon oil excise taxes for education. During the 1970s, excise tax revenues were strong and per-pupil expenditures increased 120 percent. When oil prices dropped in the 1980s, excise tax revenues decreased significantly and per-pupil expenditures (adjusted for inflation) decreased also. Oregon and Washington schools are experiencing a similar situation with the decline in timber excise tax revenues. Districts vary considerably across the region in how much they spend to educate their students, demonstrating the wide variation between and within states (NWREL, 1997). Table 5 ranks the nation's states by per-pupil expenditure as of 1994, and Table 6 indicates the range of PPE for each Northwest state.

**Table 5**
Estimated Per-Pupil Expenditure and Rank Order by State, 1994-95

| State | Per-pupil expenditure | Rank | State | Per-pupil expenditure | Rank |
|---|---|---|---|---|---|
| New Jersey | 9,774 | 1 | Missouri | 5,383 | 31 |
| New York | 9,623 | 2 | Virginia | 5,327 | 32 |
| District of Columbia | 9,335 | 3 | Texas | 5,222 | 33 |
| **Alaska** | **8,963** | **4** | Kentucky | 5,217 | 34 |
| Rhode Island | 7,469 | 5 | Georgia | 5,193 | 35 |
| Massachusetts | 7,287 | 6 | Nevada | 5,160 | 36 |
| Maryland | 7,245 | 7 | North Carolina | 5,077 | 37 |
| Pennsylvania | 7,109 | 8 | California | 4,992 | 38 |
| Delaware | 7,030 | 9 | Oklahoma | 4,845 | 39 |
| Michigan | 6,994 | 10 | South Carolina | 4,797 | 40 |
| Wisconsin | 6,930 | 11 | Arizona | 4,778 | 41 |
| Vermont | 6,750 | 12 | North Dakota | 4,775 | 42 |
| **Oregon** | **6,436** | **13** | South Dakota | 4,775 | 43 |
| Maine | 6,428 | 14 | Louisiana | 4,761 | 44 |
| Ohio | 6,162 | 15 | New Mexico | 4,586 | 45 |
| Wyoming | 6,160 | 16 | Arkansas | 4,459 | 46 |
| Illinois | 6,136 | 17 | Alabama | 4,405 | 47 |
| West Virginia | 6,107 | 18 | Tennessee | 4,388 | 48 |
| Hawaii | 6,078 | 19 | **Idaho** | **4,210** | **49** |
| Minnesota | 6,000 | 20 | Mississippi | 4,080 | 50 |
| **United States** | **5,988** | **21** | Utah | 3,656 | 51 |
| Nebraska | 5,935 | 22 | Connecticut | 8,817 | 52 |
| **Washington** | **5,906** | **23** | | | |
| New Hampshire | 5,859 | 24 | | | |
| Indiana | 5,826 | 25 | | | |
| Kansas | 5,817 | 26 | | | |
| Florida | 5,718 | 27 | | | |
| **Montana** | **5,692** | **28** | | | |
| Iowa | 5,483 | 29 | | | |
| Colorado | 5,443 | 30 | | | |

**Source:** *Digest of Education Statistics 1997*, National Center for Education Statistics, U.S. Department of Education

**Table 6**
Range and median of per-pupil expenditures in the Northwest, 1994

| | Median | Lowest | Highest |
|---|---|---|---|
| Alaska | 10,749 | 5,750 | 23,571 |
| Idaho | 3,608 | 2,652 | 10,250 |
| Montana | 4,798 | 2,250 | 30,000 |
| Oregon | 5,229 | 2,222 | 18,750 |
| Washington | 5,023 | 3,500 | 23,000 |
| NW Region | 4,947 | 2,222 | 30,000 |

* Per-pupil expenditure based on current expenditures for instruction, support services, and non-instructional services for salaries, employee benefits, purchased services and supplies. It does not include debt service expenses or capital expenditure.
**Source**: 1994 Common Core of Data, NCES

# STUDENT PARTICIPATION IN MATHEMATICS AND SCIENCE

Over the past decade, education standards in mathematics and science have been developed in response to wide concern about student achievement and the demands of an increasingly scientific, mathematical, and technical world. All five states in the Northwest are in the process of standards-based curriculum reform (Carr, 1998). Oregon and Washington have mandated comprehensive standards, and Montana has developed standards guidelines. Alaska and Idaho have developed standards guidelines as well as high school exit exams.

New standards mean that today's students are often required to engage in more advanced science and mathematics curricula than was typical a few years ago. Students are often expected to tackle higher-order concepts and problem solving. At the secondary level, they are increasingly expected to take more courses in mathematics and science. At the elementary level, it might be expected that some teachers are spending more time on mathematics and science to prepare their young students for the rigors of secondary school. While it is beyond the scope of this publication to investigate the effect new standards have had on instruction and course-taking, it is worth keeping this relationship in mind as one reflects on the following data depicting participation of students in the study of mathematics and science.

## Elementary Class Time on Mathematics and Science

The proportion of time that elementary school teachers use to teach the core academic subjects—including mathematics and science—is an important aspect of instruction. These subjects, along with English/reading/language arts and social studies, form the bedrock of the school curriculum. According to the authors of *Time Spent Teaching* (Perie, et al., 1997), the proportion of time teachers spend teaching these subjects to young students reflects the emphasis schools place on academic topics. In 1993-94, approximately two-thirds of school time in grades one through four was spent on core curriculum in elementary schools around the nation. This finding was consistent for the previous six years.

The more instruction young students receive in the core curriculum, the more they learn and the better they perform on later achievement tests, state the NCES report, *Time Spent Teaching Core Academic Subjects in Elementary Schools* (Perie, Baker, & Bobbitt, 1997). Because exposure to subjects at the elementary level is related to the courses students take at the secondary level, it is important that young students receive instruction in the core curriculum in the earliest grades.

The amount of time teachers spend on instruction in a certain subject may also enhance students' current achievement. The authors of *State Indicators of Science and Mathematics Education: 1997* (Blank & Langesen, 1997) assert that students from states in which significantly more time is spent on mathematics and on science might be expected to show higher scores on student assessments if other differences among states are taken into consideration. On the other hand, data collected as part of the Third International Mathematics and Science Study (TIMSS), conducted in 1995, show no clear pattern between the number of instructional hours in mathematics and science and student achievement in grades three through four (Mullis, Martin, Beaton, Gonzalez, Kelly, & Smith, 1997; Martin, Mullis, Beaton, Gonzalez, Smith, Kelly, 1997). Nevertheless, TIMSS researchers state that in mathematics education "common sense and research both support the idea that increased time on task can yield commensurate increases in achievement..." (Mullis, et al., 1997).

Elementary school teachers for grades four through six reported the amount of time spent per week on four academic subjects—mathematics, science, reading, and social studies—in the report, *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results* (Bandeira de Mello & Broughman, 1996), a periodic study conducted by the U.S. Department of Education's National Center for Education Statistics. About 800 teachers in each state were surveyed. Elementary class time on mathematics and science in the five Northwest states is shown in Table 7 (Blank & Langesen, 1997).

Nationally, class time on mathematics instruction in grades four through six, as reported by teachers, is quite consistent. However, cumulative differences in time can be significant—over a year, classes in states with 5.4 hours per week provide 194 hours of mathematics, while classes in the states at the low end provide 155 hours of mathematics—a difference of 39 hours, or seven weeks of classes (Blank & Langesen, 1997).

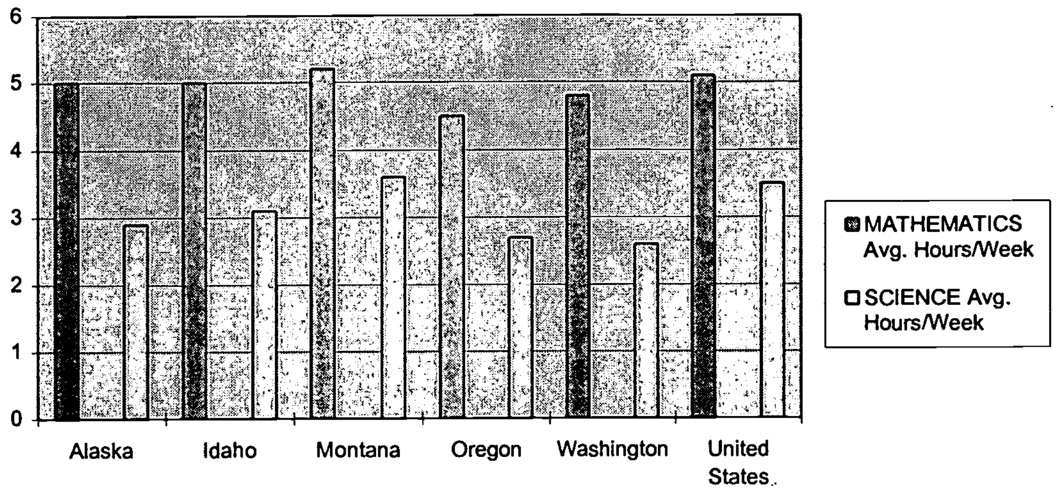
In science, class time in grades four through six varied nationally from over 3.8 hours per week, or 45 minutes per day in 12 states, to less than 2.7 hours per week in Oregon, Washington, Maryland, and Hawaii. The amount of time spent teaching science in each state is more variable than in mathematics. Over a year, classes in states with 3.8 hours per week provide 39 hours more science time than classes in states at 2.7 hours per week—or seven more weeks of science class (Blank & Langesen, 1997).

**Table 7**
Elementary Class Time Spent Per Week on Mathematics and Science, Grades 4-6, 1994

| | Mathematics Average Hours/Week | Science Average Hours/Week |
|---|---|---|
| Alaska | 5.0 | 2.9 |
| Idaho | 5.0 | 3.1 |
| Montana | 5.2 | 3.6 |
| Oregon | 4.5 | 2.7 |
| Washington | 4.8 | 2.6 |
| United States | 5.1 | 3.5 |

Source: State Indicators of Science and Mathematics Education: 1997, Council of Chief State School Officers

**Figure 3**
Elementary Class Time Spent Per Week on Mathematics and Science




## Secondary Course-Taking Patterns in Mathematics and Science

Middle school mathematics and science curricula are highly varied between states and within states. Research on patterns of student achievement in mathematics and science has shown a strong correlation between achievement and instructional time, as well as the number and level of secondary courses students take. Instructional time and course-taking in secondary mathematics and science vary widely across the nation's schools (Blank & Langesen, 1997).

### Middle Grade Mathematics

By the time a student reaches the eighth grade, different types of mathematics courses are available. In many states and districts, there is a growing emphasis on algebra in eighth-grade mathematics curricula. As part of the 1996 National Assessment of Educational Progress (NAEP) in Mathematics, eighth-grade students were asked in a questionnaire about the mathematics class they were currently taking and the class they expected to take in ninth grade (Reese, Jerry, & Ballator, 1997). Table 8 shows student responses. Although Idaho did not participate in the 1996 NAEP, the publication, *State Indicators of Science and Mathematics Education: 1997* reports that 44 percent of Idaho's eighth-grade students enrolled in regular math; 29 percent enrolled in enriched/pre-algebra; and 18 percent enrolled in grade-eight algebra in 1996 (Blank & Langesen, 1997).

**Table 8**
Percent of Grade 8 Students Who Are Enrolled in Mathematics by Course Title and the Course They Expect to Take the Following Year

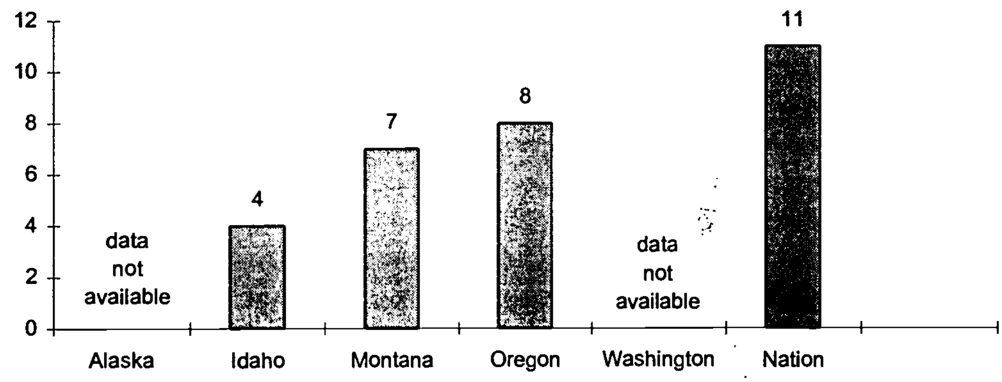
| | Alaska | Idaho | Montana | Oregon | Washington | United States |
|---|---|---|---|---|---|---|
| **What kind of mathematics class are you taking this year?** | | | | | | |
| Eighth-grade mathematics | 29 | — | 49 | 35 | 32 | 44 |
| Prealgebra | 39 | — | 22 | 27 | 33 | 27 |
| Algebra | 26 | — | 22 | 28 | 26 | 24 |
| Integrated or sequential mathematics | 1 | — | 2 | 2 | 4 | 1 |
| Applied mathematics (technical preparation) | 0 | — | 0 | 0 | 1 | 0 |
| Other mathematics class | 4 | — | 4 | 7 | 5 | 3 |
| **What kind of mathematics class do you expect to take in ninth grade?** | | | | | | |
| I do not expect to take mathematics in ninth grade | 1 | — | 1 | 2 | 1 | 1 |
| Basic, general, business, or consumer mathematics | 6 | — | 7 | 9 | 9 | 8 |
| Applied mathematics (technical preparation) | 1 | — | 2 | 2 | 1 | 2 |
| Prealgebra | 9 | — | 10 | 12 | 9 | 11 |
| Algebra 1 or elementary algebra | 35 | — | 35 | 28 | 29 | 32 |
| Geometry | 21 | — | 16 | 22 | 22 | 20 |
| Integrated or sequential mathematics | 1 | — | 3 | 2 | 5 | 2 |
| Other mathematics class | 2 | — | 3 | 3 | 2 | 3 |
| I don't know | 25 | — | 21 | 20 | 23 | 22 |

Source: The NAEP 1996 State Assessment in Mathematics
— Data not available. Idaho did not participate in the 1996 NAEP.

## High School Mathematics

All high school students should receive instruction in challenging mathematics content in the areas of algebra, functions, geometry, trigonometry, and statistics, according to the National Council of Teachers of Mathematics (1989). State and local curriculum guidelines and policies are encouraging an increase in the number of high school students taking higher level mathematics. These guidelines and policies are also attempting to decrease general mathematics and consumer mathematics courses in the high school curriculum. In 1995-96, more than 10 percent of high school students in the nation were taking general or consumer mathematics, as compared to 19 percent of high school students six years prior (Blank & Langesen, 1997).

**Figure 4**
Percent of High School Students, Grades 9-12, Enrolled in General, Consumer, or Remedial Mathematics, 1996




**Source**: State Indicators of Science and Mathematics Education: 1997, Council of Chief State School Officers

Higher-level high school mathematics has been shown to be an important door to success in college. Since the mid-1980s, many states have significantly increased their high school graduation requirements (Blank & Langesen, 1997). Many now require three years of high school mathematics for graduation. Table 8 reports the percent of high school students in the Northwest region taking each of five levels of mathematics by graduation. Nationally, 95 percent or more of students take first-year algebra or integrated mathematics level 1 by the time they graduate. (In integrated mathematics, students study a combination of key concepts often taught in separate high school courses, such as algebra, geometry, and functions.) The percentage of students taking geometry or integrated mathematics level 2 varies by state, from 95 percent (North Carolina, District of Columbia, Wisconsin) to less than 51 percent (Hawaii), with the national average at 72 percent. From 1992 to 1996, the percent of students in the nation taking geometry increased from 61 to 72 percent (Blank & Langesen, 1997).

**Table 9**
Percentage Students Taking Higher-Level Mathematics Courses by Graduation, 1996

| | Algebra 2/ Integrated Math 3 (Level 3) | Algebra 1/ Integrated Math 1 (Level 1) | Geometry/ Integrated Math 2 (Level 2) | Trigonometry/ Precalculus (Level 4) | Calculus/AP Calculus (Level 5) |
|---|---|---|---|---|---|
| Alaska | — | — | — | — | — |
| Idaho | 61 | 95+ | 66 | 29 | 12 |
| Montana | 53 | 95+ | 72 | 39 | 7 |
| Oregon | 52 | 88 | 61 | 28 | 8 |
| Washington | — | — | — | — | — |
| Nation | 62 | 95+ | 72 | 37 | 12 |

**Source**: State Indicators of Science and Mathematics Education, 1997, Council of Chief State School Officers
— Data not available.

## Middle Grade Science

As part of the 1996 National Assessment of Educational Progress in Science, eighth-grade students were asked what type of science class they were currently taking and how much time they spent in class studying science. Table 10 shows student responses from the Northwest states, except for Idaho, which did not participate in the 1996 NAEP. (According to *State Indicators of Science and Mathematics Education: 1997* (Blank & Langesen, 1997), 38 percent of Idaho's students in grades 7 and 8 enrolled in life science; 23 percent enrolled in physical science; and 16 percent enrolled in earth science. NAEP data is for only grade 8. Therefore, valid comparisons between the data for Idaho and those for the other four states is not possible.) It should be noted that students in schools with block scheduling were not identified separately in the NAEP report. Consequently, students under block scheduling who receive science instruction two to three times weekly may be receiving as much instruction as students in traditional settings who have science every day (O'Sullivan, Jerry, Ballator, Herr, 1996).

**Table 10**
Percent of Grade 8 Students Who Are Enrolled in Science by Course Title, and How Often They Study Science in School, 1996

| | Alaska | Idaho | Montana | Oregon | Washington | United States |
|---|---|---|---|---|---|---|
| **Which best describes the science course you are taking?** | | | | | | |
| I am not taking science this year | 5 | — | 1 | 4 | 7 | 3 |
| Life science | 10 | — | 10 | 17 | 17 | 12 |
| Physical science | 21 | — | 58 | 20 | 15 | 25 |
| Earth science | 24 | — | 14 | 27 | 32 | 23 |
| General science | 21 | — | 11 | 17 | 16 | 19 |
| Integrated science | 20 | — | 5 | 15 | 13 | 17 |
| About how often do you study science in school? | | | | | | |
| Never | 3 | — | 2 | 4 | 8 | 4 |
| Less than once a week | 3 | — | 2 | 2 | 3 | 4 |
| 1 or 2 times a week | 6 | — | 6 | 8 | 6 | 7 |
| 3 or 4 times a week | 28 | — | 7 | 20 | 10 | 13 |
| Every day | 60 | — | 84 | 66 | 72 | 71 |

**Source:** The NAEP 1996 State Assessment in Science
— Data not available. Idaho did not participate in NAEP 1996.

## High School Science

According to the report, *Science Proficiency and Course Taking in High School* (Madigan, 1997), the rigor of the courses students take can have a significant influence on the level of proficiency they achieve in science. Apparently, *which* science courses students take in high school can be more important to achieving proficiency than the number of science courses they take. Table 11 shows student enrollment in three Northwest states in high school courses in earth science, physical science, general science, and integrated science. There are marked differences in course enrollments by state. Nationally, some states, such as Montana and Idaho, have more than 60 percent of ninth-graders taking earth science, whereas 10 states have less than 10 percent of their ninth-grade students taking this course. Several states now have a substantial percentage of students taking an integrated or coordinated science curriculum, often starting in grade seven and continuing through grade nine or 10 (Blank & Langesen, 1997).

**Table 11**

Percent of Grade 9 Students Taking Earth Science, Physical Science, General Science, and Integrated Science, 1996

| | Earth Science | Physical Science | General Science | Integrated or Coordinated Science |
|---|---|---|---|---|
| Alaska | — | — | — | — |
| Idaho | 63 | 36 | 5 | — |
| Montana | 80 | 10 | 4 | 8 |
| Oregon | 13 | 35 | 9 | 21 |
| Washington | — | — | — | — |

**Source**: State Indicators of Science and Mathematics Education: 1997, Council of Chief State School Officers
— Data not available.

Nationally, more than 95 percent of high school students take first-year biology by graduation. In the 1980s, many states increased graduation requirements in science to two or three courses. The typical student today takes an introductory science course (earth, physical, general, or integrated science) and a course in biology. Nationally, physics enrollments vary widely by state, ranging from 56 percent to less than 12 percent (Blank & Langesen, 1997).

**Table 12**

Percent of Students Taking Higher-Level Science Courses by Graduation, 1996

| | Chemistry 1st Year (%) | Physics 1st Year (%) | Biology 1st Year (%) |
|---|---|---|---|
| Alaska | — | — | — |
| Idaho | 41 | 15 | 95+ |
| Montana | 49 | 27 | 95+ |
| Oregon | 40 | 20 | 82 |
| Washington | — | — | — |
| Nation | 55 | 24 | 95+ |

**Source**: State Indicators of Science and Mathematics Education: 1997, Council of Chief State School Officers
— Data not available.

## STUDENT ACHIEVEMENT

There have been a number of changes in assessment practices in all five Northwest states. Educators and policymakers continue to seek the most meaningful ways to measure student achievement and to tie assessments to challenging statewide standards.

States in the region are all moving away from relying solely on norm-referenced standardized tests to collect data. These kinds of tests present problems because they are created for national distribution and are not tied to the curricula. Too often, students are tested on subjects that they have not had the opportunity to learn. Norm-referenced standardized tests compare students' performance to a national sampling of their peers, rather than showing growth over time or presenting precise evidence of what students have or have not learned.

In the Northwest, states are replacing or supplementing norm-referenced standardized tests with assessments tied to statewide standards or frameworks. These tests are criterion referenced and are used to determine whether individual students have met standards, rather than comparing students to each other. Because they are aligned with state standards, the new assessments are expected to test students on what they have actually been taught.

Three major assessment categories are used in this section to depict student performance: individual statewide assessments; the Scholastic Assessment Test (SAT) from the College Entrance Examination Board, a norm-referenced test; and the National Assessment of Educational Progress (NAEP) State Level Assessment, a criterion-referenced test. In addition, results from a comparison of each state's performance on NAEP to the Third International Mathematics and Science Study (TIMSS) are presented.

### Alaska

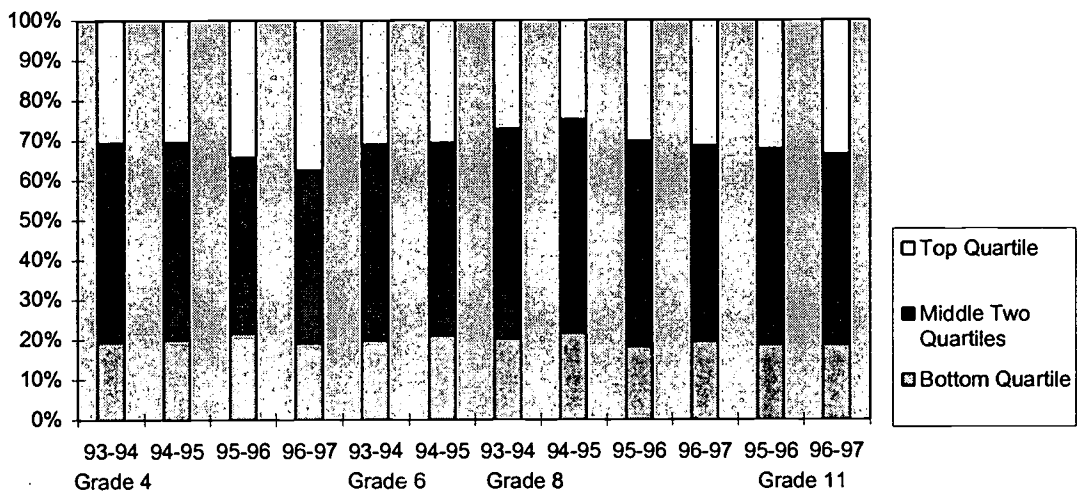
All students in Alaska are assessed in mathematics at grades four, eight, and 11. The state began using the California Achievement Test, Fifth Edition (CAT/5) in 1995. Prior to that Alaska students were tested in grades four, six, and eight using the Iowa Tests of Basic Skills (ITBS). The Alaska Department of Education points out that comparisons between scores from the two tests are problematic because of their differences. The CAT/5 has approximately half the number of test items contained on the ITBS, and there are differences in the content assessed as well (Alaska Department of Education, 1996). Alaska reports the percentage of students who fall within the first quartile (1st through 25th percentile) and the fourth quartile (76th through 99th percentile).

**Table 13**
Alaska: Distribution of Student Scores, ITBS and CAT/5, 1993-1997

| | Percentage of students scoring in the Top and Bottom Quartiles: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ITBS | | | | CAT/5 | | | |
| | 93-94 | | 94-95 | | 95-96 | | 96-97 | |
| | Top | Bottom | Top | Bottom | Top | Bottom | Top | Bottom |
| Grade 4 | 30.6 | 19.3 | 30.4 | 20.0 | 34.2 | 21.6 | 37.4 | 19.1 |
| Grade 6 | 31.0 | 19.7 | 30.6 | 21.0 | | | | |
| Grade 8 | 27.1 | 20.1 | 24.8 | 21.6 | 30.2 | 18.6 | 31.4 | 19.5 |
| Grade 11 | | | | | 32.1 | 18.6 | 33.5 | 18.6 |

Source: Alaska Department of Education, Report Card to the Public

**Figure 5**
Alaska: Distribution of Student Scores, 1993-1997




Alaska is in the process of developing mathematics and science assessments in line with their content standards (Alaska Department of Education, 1997). In June 1998, the State Board of Education approved academic performance standards that will be used to develop questions for a high school exit exam.

## Idaho

The state of Idaho tests students in grades three through eight using the Iowa Tests of Basic Skills (ITBS) and grades nine through 11 using the Tests of Achievement and Proficiency (TAP).

The ITBS and TAP are norm-referenced tests in which students are compared to a national group of their peers. According to Riverside Publishers, the company that produces the ITBS and TAP, the "Advanced Skills" scores correlate to the Core Thinking Skills described by the Association of Supervision and Curriculum Development and critical-thinking and problem-solving skills described by other groups. These include students' abilities to evaluate, analyze, and synthesize information and ideas. In mathematics, students are tested in problem solving and data interpretation in addition to computation skills.

**Table 14**

Idaho: Average Scores and National Percentile Rank, Mathematics, ITBS & TAP, 1997

| ITBS | Computation | | Concepts/ estimation | | Problem solving/ data interpretation advanced skills | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Average standard score | Percentile rank[1] | Average standard score | Percentile rank[1] | Average standard score | Percentile rank[1] | Average standard score | Percentile rank[1] |
| Grade 3 | 169.7 | 50 | 173.3 | 53 | 176.9 | 56 | 173.6 | 53 |
| Grade 4 | | | | | 198.1 | 62 | 189.2 | 49 |
| Grade 5 | 196.7 | 42 | 204.5 | 53 | 209.9 | 58 | 204.0 | 51 |
| Grade 6 | | | | | 225.8 | 58 | 218.2 | 51 |
| Grade 7 | 225.7 | 47 | 234.6 | 57 | 240.6 | 59 | 233.8 | 56 |
| Grade 8 | | | | | 255.1 | 59 | 248.9 | 59 |
| TAP | Computation | | Concepts/problem solving Advanced skills | | Concepts/problem solving Total | | Total with computation | |
| | Average standard score | Percentile rank[1] | Average standard score | Percentile rank[1] | Average standard score | Percentile rank[1] | Average standard score | Percentile rank[1] |
| Grade 9 | 243.5 | 41 | 261.0 | 55 | 261.4 | 56 | 255.7 | 53 |
| Grade 10 | | | 276.1 | 59 | | | 270.1 | 56 |
| Grade 11 | | | 286.8 | 60 | | | 278.6 | 58 |

[1]Percentile rank of average standard score: national students norms.

Source: Idaho Department of Education

**Table 15**

Idaho: Average Scores and National Percentile Rank, Science, ITBS & TAP, 1997

| | | Average standard score | Percentile rank[1] |
|---|---|---|---|
| ITBS | Grade 3 | 179.1 | 58 |
| | Grade 5 | 216.3 | 63 |
| | Grade 7 | 242.2 | 61 |
| TAP | Grade 9 | 266.4 | 60 |

[1]Percentile rank of average standard score: national students norms.

Source: Idaho Department of Education

In addition to the ITBS and TAP tests, Idaho also administers the Direct Mathematics Assessment, first implemented in 1996. These tests are not norm-referenced and reflect higher expectations for what students should know and be able to do. The Direct Mathematics Assessment is also aligned with the National Council of Teachers of Mathematics *Curriculum and Evaluation Standards*.

## Montana

Montana requires all public schools to test students at grades four, eight, and 11 in mathematics and science. In 1996-1997, districts selected a test from a list of five norm-referenced standardized tests approved by the Office of Public Instruction. The list was narrowed to three tests in 1997-98.

**Table 16**
Montana: Percentage of Students Scoring at Each Performance Level, 1996-1997

| | | Stanine 1-3 Novice | Stanine 4 Nearing Proficiency | Stanine 5-7 Proficient | Stanine 8-9 Advanced |
|---|---|---|---|---|---|
| Mathematics | Grade 4 | 16.3 | 13.8 | 55.3 | 14.7 |
| | Grade 8 | 14.3 | 14.2 | 55.4 | 16.3 |
| | Grade 11 | 12.6 | 14.2 | 56.6 | 16.5 |
| Science | Grade 4 | 11.7 | 11.8 | 56.6 | 19.9 |
| | Grade 8 | 10.2 | 11.4 | 56.0 | 22.4 |
| | Grade 11 | 9.2 | 10 | 57.6 | 23.1 |

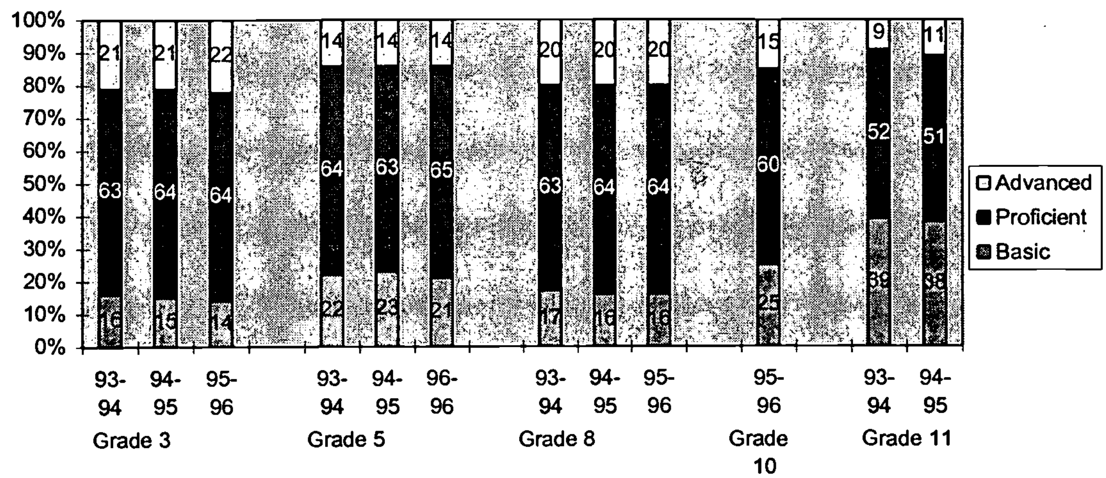
Source: Montana Office of Public Instruction.

Currently, Montana's Assessment Criteria Task Force is identifying criteria for reviewing and evaluating tests for use by Montana schools. In 1998-99, the State Board of Education will review the testing procedures in light of revised statewide standards and school improvement efforts.

## Oregon

Oregon tests students in mathematics at grades three, five, eight, and 10 using the Oregon Statewide Assessment. The multiple-choice section consists of 40 to 60 items involving algebra, geometry, statistics, probability, measurement, calculations, and estimation (Oregon Department of Education, 1998). Prior to 1995, students were tested in grade 11 rather than grade 10.

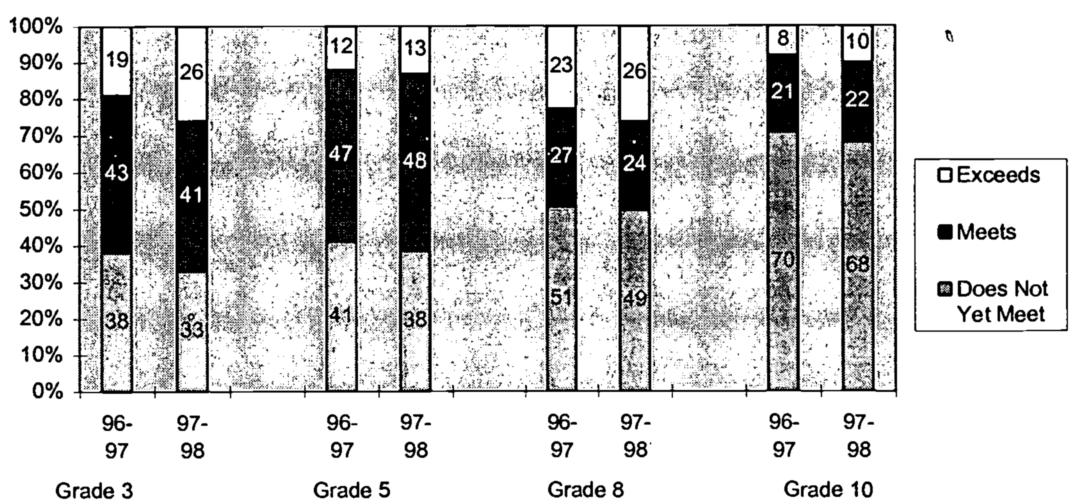
**Figure 6**
Percentage of Students Scoring at Each Performance Level Oregon Statewide Assessment, Mathematics, 1993-1996




Source: Oregon Department of Education

In 1996, the State Board of Education adopted new higher standards and the results are reported using a different scale: Not Yet Met, Met, or Exceeded the standards. The test itself did not change.

**Figure 7**
Percentage of Students Not Yet Meeting, Meeting, and Exceeding Standards

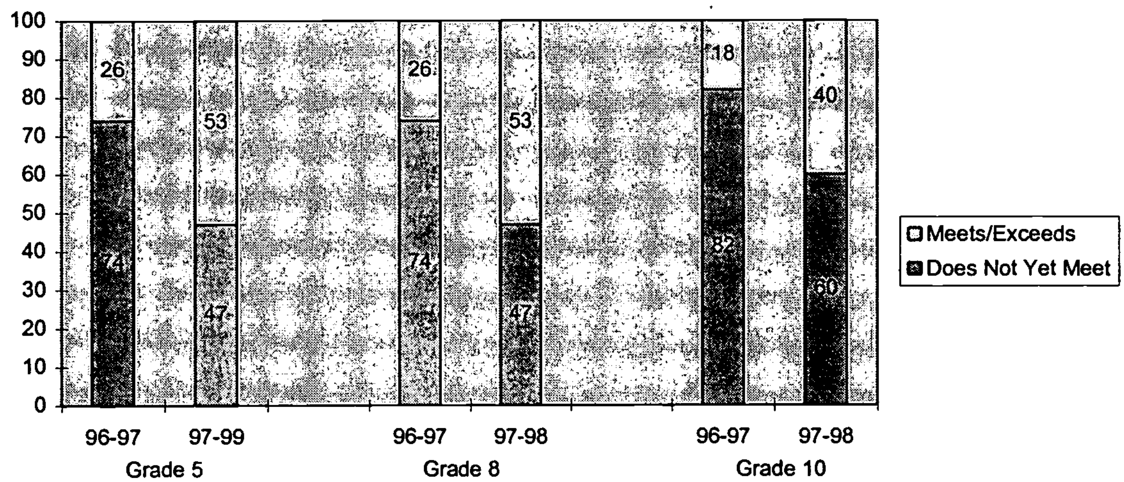



Source: Oregon Department of Education

In addition to the multiple-choice test, in 1996-97 Oregon began statewide implementation of a problem-solving mathematics assessment at grades five, eight, and 10. Students select and solve one problem from a group of 10. The problems represent the mathematics strands of calculation and estimation; measurement; statistics and probability; algebraic relationships; and geometry. Students' work is rated on four dimensions: conceptual understanding, process and strategies, communication, and verification using the Oregon State Scoring Guide (Oregon Department of Education, 1998).

**Figure 8**

Mathematics Problem-Solving Assessment
Percentage of Students Not Yet Meeting and Meeting/Exceeding Standards




A statewide assessment of science was implemented in 1997-98 at grades five, eight, and 10. The scores from this first year will serve as the baseline for student achievement and will be used to set performance standards. The science assessment tests students on five strands: unifying concepts and processes, physical science, life science, earth/space science, and scientific inquiry (Oregon Department of Education, 1998).

**Table 17**

Oregon: Results of the 1997-98 Science Assessment

| | Average score | Percentage of questions answered correctly |
|---|---|---|
| Grade 5 | 527 | 65 |
| Grade 8 | 534 | 62 |
| Grade 10 | 531 | 56 |

Source: Oregon Department of Education

## Washington

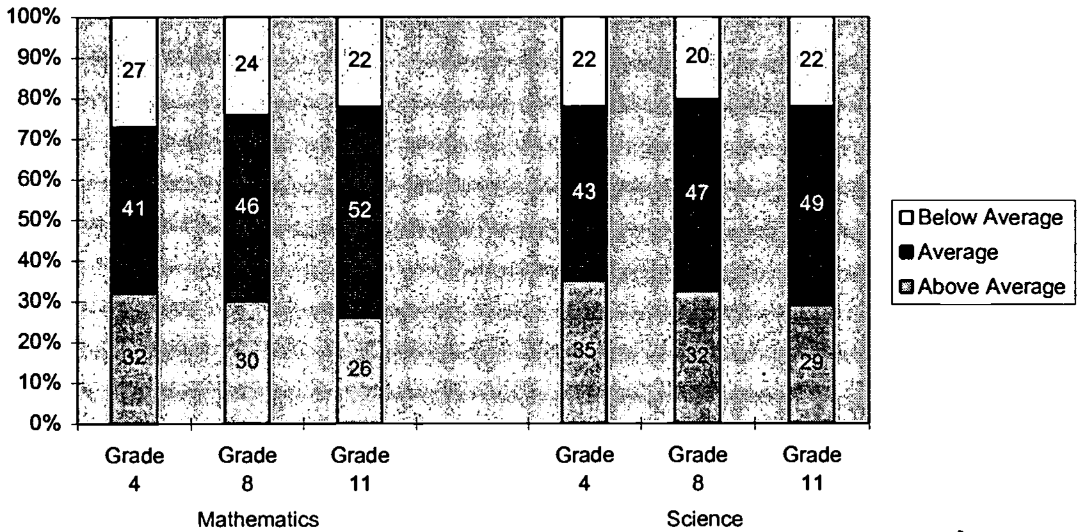
In 1991, Washington began testing students in mathematics at grades four and eight with the Comprehensive Tests of Basic Skills, 4th edition (CTBS/4) and grade 11 with the Curriculum Frameworks Assessment System (CFAS). Students in Grade 11 are also tested in science. Scores for grades four and eight are reported as average national percentile scores. The CFAS was not designed to be a nationally normed test, and the scores for grade eleven are reported as average Washington state percentile scores, using norms created for Washington based on the fall 1991 assessment (Washington Office of State Superintendent of Public Instruction, 1998b).

**Table 18**
Average Percentile Scores for CTBS/4 (Grades 4 & 8) and CFAS (Grade 11)

| | | 93-94 | 94-95 | 95-96 | 96-97 | 97-98 |
|---|---|---|---|---|---|---|
| | | Average Percentile Score | | | | |
| Grade 4 | Mathematics | 47 | 47 | 49 | 52 | 54 |
| Grade 8 | Mathematics | 52 | 53 | 53 | 55 | 54 |
| Grade 11 | Mathematics | 50 | 51 | 52 | 53 | 53 |
| Grade 11 | Science | 49 | 51 | 52 | 53 | 53 |

Source: Washington Office of State Superintendent of Public Instruction

**Figure 9**
Achievement for 1997 CTBS/4 (Grades 4 & 8) and CFAS (Grade 11)

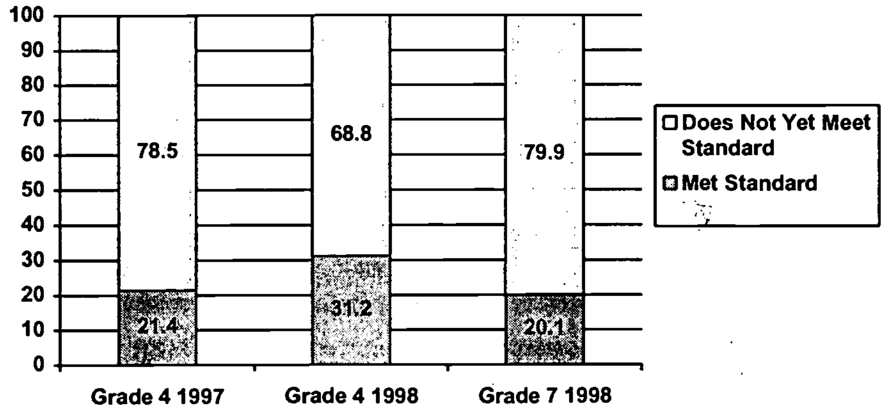



Source: Washington Office of State Superintendent of Public Instruction

In the spring of 1997, the state pilot tested the first Washington Assessment of Student Learning for fourth-grade students in mathematics. Participation was voluntary this first year. Only 21 percent of students tested were able to meet the standards. The scores reflect the technical difficulties in switching to a new system and are a sign of students and teachers striving to meet the challenge of high standards (Washington Office of State Superintendent of Public Instruction, 1998c).

Spring 1998 was the first year of full-scale implementation of the mathematics assessment in grades four and seven and the pilot test for the grade 10 assessment. Participation was mandatory for grade four in 1998. (Participation for grades seven and 10 will be voluntary until 2001). The statewide fourth-grade scores show a significant improvement in 1998.

**Figure 10**
Percent of Students Meeting or Not Yet Meeting the Standards, Washington Assessment of Student Learning, Grades 4 and 8, 1997-98




Source: Washington Office of State Superintendent of Public Instruction

The Improving America's Schools Act of 1994 requires states who receive federal funds to disaggregate assessment data by gender, ethnicity, English language proficiency, migrant status, disability, and socioeconomic status. This process enables states, districts, and schools to ensure that they are serving all students equally. Disaggregated data can help educators to plan and design strategies to address the needs of the students and communities they serve. States in the Northwest are working to address this area of data collection, but there is still a lack of disaggregated data available. Washington seems to be leading the region by providing data disaggregated by gender and race in their regular assessment reports.

**Table 19**
Student Performance on Washington Assessment of Students Learning by Gender and Race, 1998

| | Grade 4 | | Grade 7 | |
|---|---|---|---|---|
| | Met standard | Does not yet meet standard | Met standard | Does not yet meet standard |
| Males | 31.9 | 68.1 | 19.2 | 80.8 |
| Females | 30.6 | 69.7 | 21.0 | 79.0 |
| Native American/ Alaskan Native | 13.9 | 86.1 | 5.7 | 94.3 |
| Asian/Pacific Islander | 33.5 | 66.5 | 24.8 | 75.2 |
| Black/African American | 13.0 | 87.0 | 4.9 | 95.1 |
| Hispanic | 11.3 | 88.7 | 5.5 | 94.5 |
| White | 35.3 | 64.7 | 22.6 | 77.4 |
| Multi-racial | 24.5 | 75.5 | 10.9 | 89.1 |

Source: Washington Office of State Superintendent of Public Instruction

The new assessment system is criterion referenced and is designed to measure student progress toward achieving the Essential Academic Learning Requirements. The new assessments require students to both select and create answers, with multiple-choice, short answer, extended response, and problem-solving tasks (Washington Commission on Student Learning, 1998).

## Scholastic Assessment Test (SAT)

The Scholastic Assessment Test (SAT) tests students' verbal and mathematical abilities and is administered by the College Entrance Examination Board. It is designed to predict success in college and to track the performance of students who intend to enter college.

SAT scores are reported on a scale of 200 to 800. It is difficult to compare average scores between states because of the varying percentages of students who take the test in each state. Comparisons between years must also be made with caution, because the percentage of students taking the test varies from year to year (College Entrance Examination Board, 1998).

**Table 20**

Average SAT Scores in Mathematics by State, 1993-1998

| | 93-94 | 94-95 | 95-96 | 96-97 | 97-98 | Percent of graduates tested[1] |
|---|---|---|---|---|---|---|
| Alaska | 477 | 513 | 513 | 517 | 520 | 52 |
| Idaho | 508 | 532 | 536 | 539 | 544 | 16 |
| Montana | 523 | 553 | 547 | 548 | 546 | 24 |
| Oregon | 491 | 522 | 521 | 524 | 528 | 53 |
| Washington | 488 | 517 | 519 | 523 | 526 | 53 |
| U.S. | 479 | 506 | 508 | 511 | 512 | 43 |

[1]Based on the number of high school graduates in 1998 as projected by the Western Interstate Commission for Higher Education and the number of 1998 seniors who took the SAT 1: Reasoning Test.

Source: College Entrance Examination Board, SAT 1998 College-Bound Seniors: National Report.

A significant number of students in the Northwest take part in the ACT Assessment, administered by the American College Testing Program. The ACT assesses students in English, mathematics, reading, and science. At the time that this publication went to press, data was not available on mathematics and science achievement for individual states.

## National Assessment of Educational Progress

The National Assessment of Educational Progress (NAEP) is the only nationally representative and continuing assessment of what students in the United States know and can do. The annual test is authorized by Congress and directed by the National Center for Educational Statistics of the U.S. Department of Education. Alaska, Montana, Oregon, and Washington participated in the 1996 assessment (Idaho did not participate in 1996).

### Mathematics

The mathematics assessment for grades four and eight began in 1973. Participation in NAEP is voluntary and included 48 states and territories in 1996. Major changes were made in the 1990s to complement the National Council of Teachers of Mathematics *Curriculum and Evaluation Standards*. Students are tested in five content strands: number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and algebra and functions.

Over the past few years, the test has been revised to include constructed response questions focusing on reasoning and communication, as well as items requiring students to connect their learning across content strands. In 1996, students spent 50 percent of test time on constructed response questions which required them to provide an answer they calculated or to write a sentence or two to describe their solution (Reese, Jerry, & Ballator, 1997).

The NAEP mathematics scale ranges from 0 to 500. Student responses to assessment questions are analyzed to determine the percentage of students responding correctly to each multiple choice question and the percentage of students achieving each of several score categories for constructed-response questions.

**Table 21**
Distribution of Mathematics Scale Scores for Public School Students - Grade Four

| | Average Scale Score | 10th Percentile | 25th Percentile | 50th Percentile | 75th Percentile | 90th Percentile |
|---|---|---|---|---|---|---|
| Alaska | 224 (1.3) | 184 (2.4) | 205 (1.5) | 225 (1.5) | 245 (1.1) | 261 (1.2) |
| Montana | 228 (1.2) | 192 (1.6) | 210 (2.2) | 229 (1.3) | 247 (1.2) | 261 (1.4) |
| Oregon | 223 (1.4) | 182 (2.2) | 204 (1.4) | 226 (1.6) | 245 (1.5) | 261 (1.4) |
| Washington | 225 (1.2) | 187 (2.1) | 207 (1.6) | 226 (1.4) | 245 (0.9) | 261 (1.3) |
| Nation | 222 (1.0) | 180 (1.5) | 201 (1.3) | 224 (1.3) | 244 (1.0) | 261 (1.0) |

Source: NCES, National Assessment of Educational Progress (NAEP), 1996 Mathematics Assessment.
The standard errors of the statistics appear in parentheses. It can be said with about 95 percent confidence that, for each population of interest, the value for the entire population is within ± 2 standard errors of the estimate for the sample. In comparing two estimates, one must use the standard error of the difference.

**Table 22**

Distribution of Mathematics Scale Scores for Public School Students - Grade 8

| | Average Scale Score | 10th Percentile | 25th Percentile | 50th Percentile | 75th Percentile | 90th Percentile |
|---|---|---|---|---|---|---|
| Alaska | 278 (1.8) | 228 (3.9) | 253 (3.2) | 280 (1.2) | 304 (2.1) | 235 (4.1) |
| Montana | 283 (1.3) | 242 (2.7) | 262 (1.5) | 285 (1.7) | 306 (0.8) | 324 (1.8) |
| Oregon | 271 (1.0) | 228 (1.3) | 249 (0.8) | 272 (1.0) | 294 (1.5) | 314 (1.3) |
| Washington | 276 (1.3) | 232 (2.1) | 253 (1.7) | 278 (1.4) | 300 (1.1) | 320 (1.7) |
| Nation | 271 (1.2) | 222 (2.0) | 247 (1.2) | 272 (1.1) | 296 (1.4) | 316 (2.0) |

Source: NCES, National Assessment of Educational Progress (NAEP), 1996 Mathematics Assessment.
The standard errors of the statistics appear in parentheses. It can be said with about 95 percent confidence that, for each population of interest, the value for the entire population is within $\pm$ 2 standard errors of the estimate for the sample. In comparing two estimates, one must use the standard error of the difference.

## Science

The 1996 NAEP Science assessment was the first to be reported on a state-by-state basis. Students were tested in grade eight only. In 1996, 44 states or territories participated in the science assessment, including the District of Columbia and Department of Defense schools.

The science assessment included multiple-choice questions to assess students' factual knowledge, but 80 percent of the test time was devoted to constructed response questions requiring short or extended answers. The constructed response questions were designed to demonstrate students' ability to explain, apply, and communicate scientific information. The NAEP assessment also included hands-on tasks to assess students' abilities to make observations, perform investigations, and apply problem-solving skills (O'Sullivan, Jerry, & Ballator, 1997).

The test was structured according to a matrix that consisted of the three traditional fields of science (earth, physical, life) crossed with three processes of knowing and doing science (conceptual understanding, scientific investigation, practical reasoning).

The NAEP science scale ranges from 0 to 300. Student responses to the assessment questions were analyzed to determine the percentage of students responding correctly to each multiple-choice question and the percentage of students achieving each of several score categories for constructed-response questions.

**Table 23**

Distribution of Science Scale Scores for Public School Students - Grade 8

| | Average Scale Score | 10th Percentile | 25th Percentile | 50th Percentile | 75th Percentile | 90th Percentile |
|---|---|---|---|---|---|---|
| Alaska | 153 (1.3) | 111 (2.9) | 133 (1.9) | 156 (1.4) | 175 (1.6) | 192 (1.7) |
| Montana | 162 (1.2) | 127 (2.6) | 146 (1.7) | 164 (1.2) | 180 (0.6) | 194 (1.9) |
| Oregon | 155 (1.6) | 115 (3.3) | 136 (2.3) | 157 (1.4) | 176 (1.2) | 192 (1.4) |
| Washington | 150 (1.3) | 108 (2.3) | 130 (2.2) | 152 (1.5) | 172 (1.6) | 189 (1.4) |
| Nation | 148 (0.9) | 102 (1.6) | 126 (1.3) | 151 (0.9) | 172 (1.1) | 191 (1.3) |

Source: NCES, National Assessment of Educational Progress (NAEP), 1996 Science Assessment.
The standard errors of the statistics appear in parentheses. It can be said with about 95 percent confidence that, for each population of interest, the value for the entire population is within $\pm$ 2 standard errors of the estimate for the sample. In comparing two estimates, one must use the standard error of the difference.

## NAEP and the Third International Mathematics and Science Study

The Third International Mathematics and Science Study (TIMSS) is the largest, most comprehensive, and most rigorous international study of school and student achievement ever conducted. More than a half-million students in 41 countries were tested. When the results began to be released in 1995, there was interest in establishing a way for individual states to compare their performance to that of other nations. As a result, the National Center for Educational Statistics (NCES) established a link between the National Assessment of Educational Progress (NAEP) and TIMSS. *Linking the National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS): Eighth-Grade Results* provides predicted TIMSS results for given NAEP results in grade eight mathematics and science (Johnson & Siegendorf, 1998). A link for grade four mathematics and science was also attempted but was still undergoing review at the time this publication went to press.

The link between TIMSS and NAEP was established by using data from the few states in which data from both assessment were available. In 1995, Minnesota elected to participate in the grade eight TIMSS assessment, and the results predicted from the NAEP scores were quite close to the actual TIMSS results. In 1997, Missouri and Oregon participated in a special assessment of TIMSS, and the predicted results were reasonably close to actual TIMSS results. (For more data from the Oregon TIMSS assessment, see page 39.)

The results of the comparison of NAEP and TIMSS are adequate for approximate comparisons of the relative rankings of individual states versus other countries. However, the results are not adequate for extensive analyses and are not appropriate for comparing performance between states or between countries.

## Alaska

*Mathematics*

Nations whose performance is expected to be:

| Higher than Alaska | Not significantly different from Alaska | | Lower than Alaska |
|---|---|---|---|
| Belgium—Flemish | (Australia) | (Israel) | (Colombia) |
| Czech Republic | (Austria) | (Latvia—LSS) | Cyprus |
| Hong Kong | (Belgium—French) | (Netherlands) | (Greece) |
| Japan | (Bulgaria) | New Zealand | Iran, Islamic Republic |
| Korea | Canada | Norway | (Kuwait) |
| Singapore | (Denmark) | Russian Federation | (Lithuania) |
| Slovak Republic | (England) | (Scotland) | Portugal |
| (Switzerland) | France | (Slovenia) | (Romania) |
| | (Germany) | Sweden | (South Africa) |
| | Hungary | (Thailand) | Spain |
| | Iceland | (United States) | |
| | Ireland | | |

Names appear in parentheses if a nation, did not satisfy one or more of the rigorous sample participation guidelines established by TIMSS.

*Science*

Nations whose performance is expected to be:

| Higher than Alaska | Not significantly different from Alaska | | Lower than Alaska |
|---|---|---|---|
| Czech Republic | (Australia) | Korea | (Belgium—French) |
| Japan | (Austria) | (Netherlands) | (Colombia) |
| Singapore | Belgium—Flemish | New Zealand | Cyprus |
| | (Bulgaria) | Norway | (Denmark) |
| | Canada | Russian Federation | France |
| | (England) | Slovak Republic | (Greece) |
| | (Germany) | (Slovenia) | Iceland |
| | Hong Kong | Sweden | Iran, Islamic Republic |
| | Hungary | (Switzerland) | (Kuwait) |
| | Ireland | (Thailand) | (Latvia—LSS) |
| | (Israel) | (United States) | (Lithuania) |
| | | | Portugal |
| | | | (Romania) |
| | | | (Scotland) |
| | | | (South Africa) |
| | | | Spain |

Names appear in parentheses if a nation, did not satisfy one or more of the rigorous sample participation guidelines established by TIMSS.

## Montana

*Mathematics*

Nations whose performance is expected to be:

| Higher than Montana | Not significantly different from Montana | Lower than Montana |
|---|---|---|
| Belgium—Flemish | (Australia) | (Colombia) |
| Czech Republic | (Austria) | Cyprus |
| Hong Kong | (Belgium—French) | (Denmark) |
| Japan | (Bulgaria) | (England) |
| Korea | Canada | (Greece) |
| Singapore | France | Iceland |
| | (Germany) | Iran, Islamic Republic |
| | Hungary | (Kuwait) |
| | Ireland | (Latvia—LSS) |
| | (Israel) | (Lithuania) |
| | (Netherlands) | Norway |
| | New Zealand | Portugal |
| | Russian Federation | (Romania) |
| | Slovak Republic | (Scotland) |
| | (Slovenia) | (South Africa) |
| | Sweden | Spain |
| | (Switzerland) | (United States) |
| | (Thailand) | |

Names appear in parentheses if a nation, did not satisfy one or more of the rigorous sample participation guidelines established by TIMSS.

*Science*

Nations whose performance is expected to be:

| Higher than Montana | Not significantly different from Montana | Lower than Montana | |
|---|---|---|---|
| Singapore | (Austria) | (Australia) | (Latvia—LSS) |
| | Belgium—Flemish | (Belgium—French) | (Lithuania) |
| | (Bulgaria) | Canada | New Zealand |
| | Czech Republic | (Colombia) | Norway |
| | (England) | Cyprus | Portugal |
| | Hungary | (Denmark) | (Romania) |
| | Japan | France | Russian Federation |
| | Korea | (Germany) | (Scotland) |
| | (Netherlands) | (Greece) | Slovak Republic |
| | (Slovenia) | Hong Kong | (South Africa) |
| | | Iceland | Spain |
| | | Iran, Islamic Republic | Sweden |
| | | Ireland | (Switzerland) |
| | | (Israel) | (Thailand) |
| | | (Kuwait) | (United States) |

Names appear in parentheses if a nation, did not satisfy one or more of the rigorous sample participation guidelines established by TIMSS.

## Oregon

*Mathematics*

Nations whose performance is expected to be:

| Higher than Oregon | Not significantly different from Oregon | | Lower than Oregon |
|---|---|---|---|
| (Austria) | (Australia) | (Latvia—LSS) | (Colombia) |
| Belgium—Flemish | (Belgium—French) | (Netherlands) | Cyprus |
| Czech Republic | (Bulgaria) | New Zealand | (Greece) |
| France | Canada | Norway | Iran, Islamic Republic |
| Hong Kong | (Denmark) | Russian Federation | (Kuwait) |
| Hungary | (England) | (Scotland) | (Lithuania) |
| Japan | (Germany) | Sweden | Portugal |
| Korea | Iceland | (Thailand) | (Romania) |
| Singapore | Ireland | (United States) | (South Africa) |
| Slovak Republic | (Israel) | | Spain |
| (Slovenia) | | | |
| (Switzerland) | | | |

Names appear in parentheses if a nation, did not satisfy one or more of the rigorous sample participation guidelines established by TIMSS.

*Science*

Nations whose performance is expected to be:

| Higher than Oregon | Not significantly different from Oregon | | Lower than Oregon | |
|---|---|---|---|---|
| Singapore | (Australia) | Japan | (Belgium—French) | (Kuwait) |
| | (Austria) | Korea | (Colombia) | (Latvia—LSS) |
| | Belgium—Flemish | (Netherlands) | Cyprus | (Lithuania) |
| | (Bulgaria) | New Zealand | (Denmark) | Portugal |
| | Canada | Norway | France | (Romania) |
| | Czech Republic | Russian Federation | (Greece) | (Scotland) |
| | (England) | Slovak Republic | Hong Kong | (South Africa) |
| | (Germany) | (Slovenia) | Iceland | Spain |
| | Hungary | Sweden | Iran, Islamic Republic | (Switzerland) |
| | Ireland | (Thailand) | | |
| | (Israel) | (United States) | | |

Names appear in parentheses if a nation, did not satisfy one or more of the rigorous sample participation guidelines established by TIMSS.

## Washington

*Mathematics*

Nations whose performance is expected to be:

| Higher than Washington | Not significantly different from Washington | | Lower than Washington |
|---|---|---|---|
| (Austria) | (Australia) | (Latvia—LSS) | (Colombia) |
| Belgium—Flemish | (Belgium—French) | (Netherlands) | Cyprus |
| Czech Republic | (Bulgaria) | New Zealand | (Greece) |
| France | Canada | Norway | Iran, Islamic Republic |
| Hong Kong | (Denmark) | Russian Federation | (Kuwait) |
| Hungary | (England) | (Scotland) | (Lithuania) |
| Japan | (Germany) | Sweden | Portugal |
| Korea | Iceland | (Thailand) | (Romania) |
| Singapore | Ireland | (United States) | (South Africa) |
| Slovak Republic | (Israel) | | Spain |
| (Slovenia) | | | |
| (Switzerland) | | | |

Names appear in parentheses if a nation, did not satisfy one or more of the rigorous sample participation guidelines established by TIMSS.

*Science*

Nations whose performance is expected to be:

| Higher than Washington | Not significantly different from Washington | | Lower than Washington |
|---|---|---|---|
| (Bulgaria) | (Australia) | New Zealand | (Belgium—French) |
| Czech Republic | (Austria) | Norway | (Colombia) |
| Japan | Belgium—Flemish | Russian Federation | Cyprus |
| Korea | Canada | (Scotland) | (Denmark) |
| Singapore | (England) | Slovak Republic | France |
| | (Germany) | (Slovenia) | (Greece) |
| | Hong Kong | Spain | Iceland |
| | Hungary | Sweden | Iran, Islamic Republic |
| | Ireland | (Switzerland) | (Kuwait) |
| | (Israel) | (Thailand) | (Latvia—LSS) |
| | (Netherlands) | (United States) | (Lithuania) |
| | | | Portugal |
| | | | (Romania) |
| | | | (South Africa) |

Names appear in parentheses if a nation, did not satisfy one or more of the rigorous sample participation guidelines established by TIMSS.

## Oregon TIMSS Results

In 1997, the U.S. Department of Education provided an opportunity for individual states to administer the TIMSS tests at the eighth grade level and thus compare the achievement of their state's students to the international results. Oregon and Missouri elected to participate and administered the test in April and May of 1997.

### Mathematics

In mathematics, the average Oregon score of 525 was not significantly different than the international average of 513. However, Oregon eighth-graders outperformed their peers from 17 countries, including the United States. Approximately 9 percent of Oregon students achieved at or above the top 10 percent level of students internationally, compared to a national average of 5 percent for U.S. students.

Eighth-grade students in Oregon scored significantly above the international average in data representation. In fractions, geometry, algebra, measurement, and proportionality, Oregon students performed approximately at the international average (Mullis, et al., 1998).

**Table 24**

Percent of Students Achieving International Marker Levels in Mathematics

| Country | Mean scale score | Top 10% level | Top quarter level | Top half level |
|---|---|---|---|---|
| Singapore | 643 | 45 (2.5) | 74 (2.1) | 94 (0.8) |
| Korea | 607 | 34 (1.1) | 58 (1.0) | 82 (0.8) |
| Japan | 605 | 32 (0.8) | 58 (0.9) | 83 (0.6) |
| Hong Kong | 588 | 27 (2.1) | 53 (2.6) | 80 (2.4) |
| Belgium | 565 | 17 (1.2) | 41 (2.3) | 73 (2.9) |
| Czech Republic | 564 | 18 (1.9) | 39 (2.3) | 70 (1.9) |
| Slovak Republic | 547 | 12 (1.0) | 33 (1.5) | 64 (1.6) |
| Switzerland | 545 | 11 (0.7) | 33 (1.2) | 65 (1.4) |
| France | 538 | 7 (0.8) | 26 (1.5) | 63 (1.5) |
| Hungary | 537 | 11 (0.8) | 29 (1.3) | 60 (2.6) |
| Russian Federation | 535 | 10 (0.7) | 29 (2.4) | 60 (2.6) |
| Ireland | 527 | 9 (1.0) | 27 (1.7) | 57 (2.4) |
| Canada | 527 | 7 (0.7) | 25 (1.1) | 58 (1.2) |
| Oregon | 525 | 9 (1.1) | 27 (1.7) | 55 (2.1) |
| Sweden | 519 | 5 (0.5) | 22 (1.2) | 53 (1.5) |
| New Zealand | 508 | 6 (0.8) | 20 (1.6) | 48 (2.2) |
| England | 506 | 7 (0.6) | 20 (1.1) | 48 (1.4) |
| Norway | 503 | 4 (0.4) | 17 (0.9) | 46 (1.2) |
| United States | 500 | 5 (0.6) | 18 (1.5) | 45 (2.3) |
| Latvia | 493 | 3 (0.5) | 14 (1.2) | 40 (1.5) |
| Spain | 487 | 2 (0.2) | 10 (0.7) | 36 (1.2) |
| Iceland | 487 | 1 (0.3) | 10 (1.3) | 37 (2.9) |
| Lithuania | 477 | 1 (0.3) | 10 (1.0) | 34 (1.8) |
| Cyprus | 474 | 2 (0.3) | 11 (0.6) | 34 (1.1) |
| Portugal | 454 | 0 (0.1) | 2 (0.4) | 19 (1.3) |
| Iran | 428 | 0 (0.0) | 0 (0.2) | 9 (0.8) |

Source: *Mathematics achievement in Missouri and Oregon in and international context: 1997 TIMSS benchmarking*, TIMSS International Study Center, Boston College, 1998.

## Science

In science, the average Oregon score of 564 was significantly higher that the international average of 516 and similar to the average scores of other high-performing countries. Only students from Singapore outperformed Oregon students. Approximately 21 percent of Oregon students achieved at or above the top 10 percent level of students internationally, compared to a national average of 13 percent for U.S. students.. Oregon eighth-grade students performed significantly above the international average in all science content areas (Martin, et al., 1998).

**Table 25**

Percent of Students Achieving International Marker Levels in Science

| Country | Mean scale score | Top 10% level | Top quarter level | Top half level |
|---|---|---|---|---|
| Singapore | 607 | 31 (2.3) | 56 (2.5) | 82 (1.6) |
| Czech Republic | 574 | 19 (1.6) | 41 (2.1) | 72 (1.6) |
| Japan | 571 | 18 (0.6) | 41 (0.8) | 71 (0.7) |
| Korea | 565 | 18 (0.8) | 39 (0.9) | 68 (0.9) |
| Oregon | 564 | 21 (1.3) | 40 (1.5) | 64 (1.7) |
| Hungary | 554 | 14 (0.8) | 34 (1.3) | 63 (1.4) |
| England | 552 | 17 (0.9) | 34 (1.4) | 60 (1.4) |
| Belgium | 550 | 10 (0.8) | 31 (1.8) | 64 (2.1) |
| Slovak Republic | 544 | 12 (0.9) | 30 (1.4) | 59 (1.5) |
| Russian Federation | 538 | 11 (0.8) | 29 (1.3) | 56 (1.8) |
| Ireland | 538 | 12 (0.9) | 29 (1.6) | 57 (2.0) |
| Sweden | 535 | 9 (0.6) | 27 (1.2) | 56 (1.5) |
| United States | 534 | 13 (0.8) | 30 (1.6) | 55 (1.9) |
| Canada | 531 | 9 (0.6) | 25 (0.9) | 54 (1.3) |
| Norway | 527 | 7 (0.5) | 24 (0.9) | 52 (1.1) |
| New Zealand | 525 | 11 (0.9) | 26 (1.5) | 51 (1.9) |
| Hong Kong | 522 | 7 (0.8) | 22 (1.5) | 51 (2.3) |
| Switzerland | 522 | 7 (0.6) | 23 (1.0) | 51 (1.2) |
| Spain | 517 | 4 (0.3) | 18 (0.7) | 47 (1.0) |
| France | 498 | 1 (0.2) | 11 (0.8) | 37 (1.5) |
| Iceland | 494 | 2 (0.5) | 10 (1.3) | 36 (2.1) |
| Latvia | 485 | 2 (0.3) | 10 (0.7) | 33 (1.3) |
| Portugal | 480 | 1 (0.1) | 7 (0.6) | 28 (1.2) |
| Lithuania | 476 | 1 (0.3) | 8 (0.8) | 29 (1.7) |
| Iran | 470 | 1 (0.1) | 5 (0.6) | 24 (1.5) |
| Cyprus | 463 | 1 (0.2) | 7 (0.5) | 26 (0.9) |

Source: *Science achievement in Missouri and Oregon in and international context: 1997 TIMSS benchmarking*, TIMSS International Study Center, Boston College, 1998.

## TEACHER CHARACTERISTICS

In the Northwest, there is a longstanding mismatch between the racial/ethnic make-up of the region's teaching force and its student population. The teaching force in the Northwest is essentially White, while the student population is increasingly diverse in its racial and ethnic makeup. In 1994, 95.2 percent of teachers in the Northwest were White (Table 26), while 17.4 percent of the region's student population was minority (Table 27). Many long-term teachers who in the past had little direct experience teaching minority students, and limited training in multicultural education, are now teaching a growing number of minority students in their classrooms (NWREL, 1997).

**Table 26**
Public School Teachers by Race/Ethnicity, 1993-94

| | Percent of teachers who are: African American | Hispanic | Asian/Pacific Islander | Alaska Native/ Native American | Minority | White |
|---|---|---|---|---|---|---|
| Alaska | 1.4 | 2.4 | 1.5 | 5.4 | 10.7 | 89.3 |
| Idaho | 0 | 1.5 | 0.8 | 0.2 | 2.4 | 97.6 |
| Montana | 0 | 0.8 | 0.4 | 2.5 | 3.8 | 96.2 |
| Oregon | 0.5 | 2.2 | 1.0 | 0.6 | 4.3 | 95.7 |
| Washington | 0.5 | 1.6 | 2.0 | 1.0 | 5.1 | 94.9 |
| NW region | 0.5 | 1.7 | 1.4 | 1.3 | 4.8 | 95.2 |
| United States | 7.4 | 4.2 | 0.8 | 1.1 | 13.5 | 86.5 |

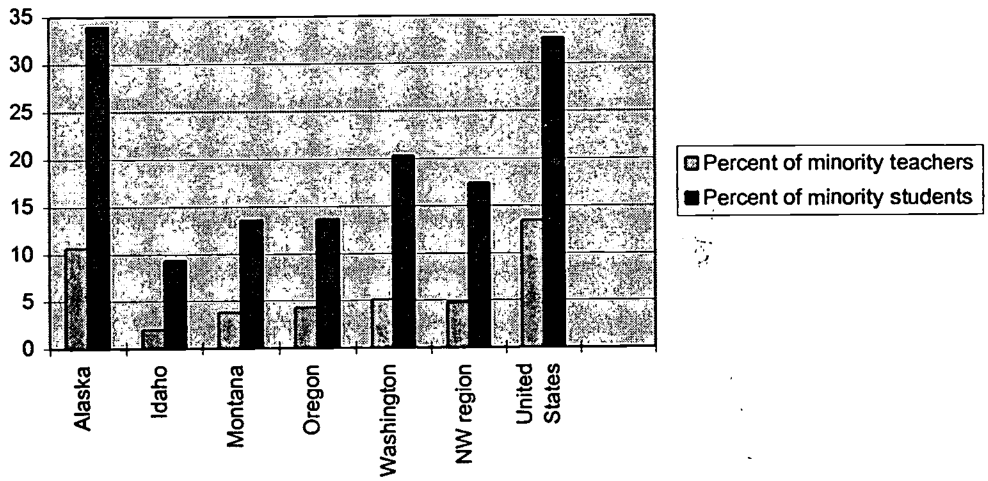
**Source:** *Schools and Staffing in the United States: A Statistical Profile, 1993-94*, NCES, U.S. Department of Education

**Table 27**
Public School Students by Race/Ethnicity, 1993-94

| | Percent of students who are: African American | Hispanic | Asian/Pacific Islander | Alaska Native/ Native American | Minority | White |
|---|---|---|---|---|---|---|
| Alaska | 4.2 | 2.3 | 3.7 | 23.9 | 34.0 | 66.0 |
| Idaho | 0.4 | 7.2 | 0.8 | 1.0 | 9.4 | 90.6 |
| Montana | 0.4 | 1.1 | 0.8 | 11.2 | 13.6 | 86.5 |
| Oregon | 2.6 | 5.8 | 2.8 | 2.4 | 13.7 | 86.3 |
| Washington | 4.2 | 7.0 | 6.5 | 2.6 | 20.3 | 79.7 |
| NW region | 3.0 | 5.9 | 4.1 | 4.4 | 17.4 | 82.5 |
| United States | 16.3 | 11.9 | 3.4 | 1.1 | 32.7 | 67.3 |

**Source:** *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results*, NCES, U.S. Department of Education

**Figure 11**
Percent Minority Teachers and Students, 1993-94




**Source**: *Schools and Staffing in the United States: A Statistical Profile, 1993-94*; and *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results*, NCES, U.S. Department of Education

As national enrollment of minority students has increased, so has the number of minority students taking mathematics and science courses. Nationally, 32.7 percent of K-12 students in public schools in 1994 were students from minority populations, while only 13.5 percent of all teachers were from an ethnic minority group. Considering the ethnic and cultural diversity of the nation's student population, minority science and mathematics teachers continue to be vastly underrepresented. Although female teachers continue to be underrepresented in mathematics and science, the disproportion is less than for ethnic minority teachers (Blank & Langesen, 1997).

**Table 28**
Public School Secondary Science & Mathematics Teachers by Race/Ethnicity and Gender, 1993-94

| | Female science | Female math | Minority science | Minority math |
|---|---|---|---|---|
| Alaska | 16.6 | 36.5 | 5.6 | 10.8 |
| Idaho | 22.5 | 42.3 | 1.7 | 1.5 |
| Montana | 15.0 | 30.5 | 0.0 | 2.0 |
| Oregon | 24.4 | 22.5 | 3.6 | 2.0 |
| Washington | 39.2 | 34.8 | 9.5 | 6.7 |
| United States | 41.6 | 51.3 | 10.3 | 10.9 |

**Source**: *SASS by State, 1993-94 Schools and Staffing Survey: Selected State Results*, NCES, U.S. Department of Education

**Figure 12**
Percentage of Secondary Science and Mathematics Teachers Who are Female

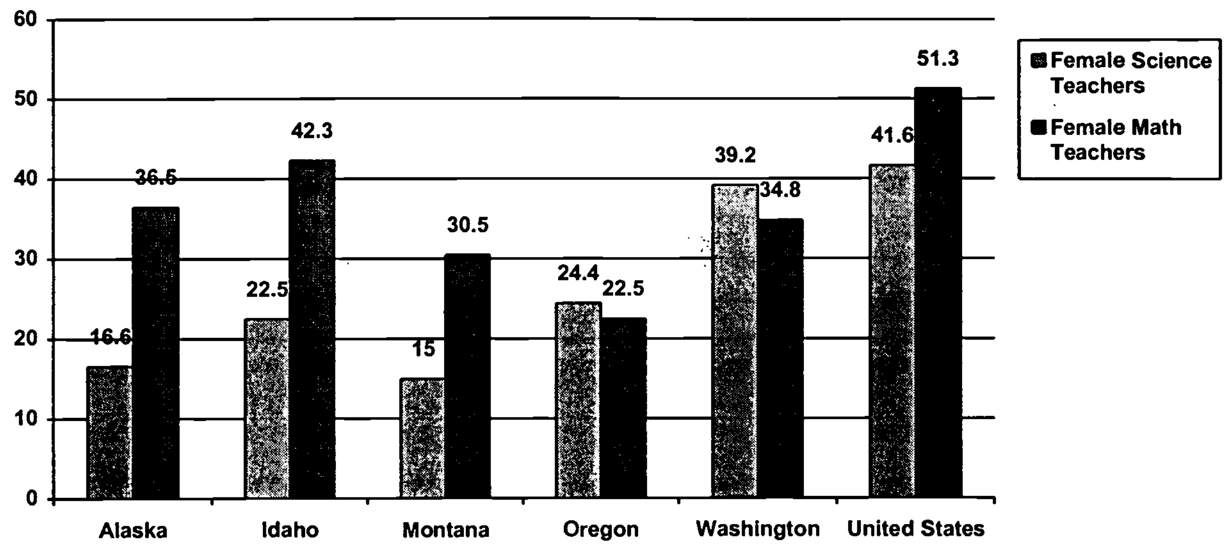
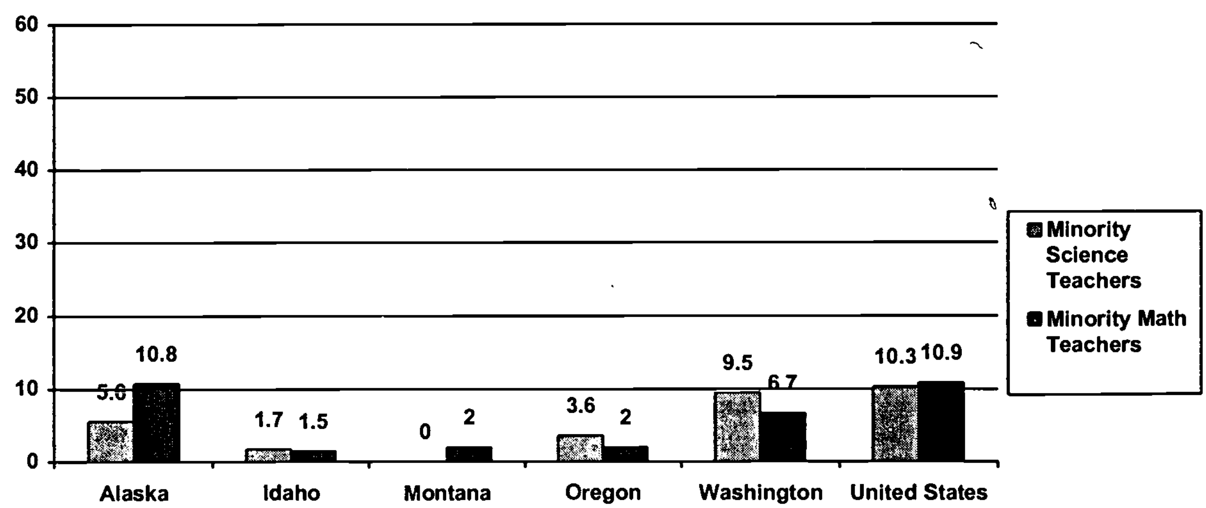



**Figure 13**
Percentage of Secondary Science and Mathematics Teachers Who are Minority




## Teaching Assignments

According to the report, *Out-of-Field Teaching and Educational Equality* (Ingersoll & Gruber, 1996), a publication of the U.S. Department of Education's National Center for Education Statistics (NCES), adequately qualified staffing requires teachers at the secondary school level to hold at least a college minor in the fields they teach. The report notes that knowledge of subject matter does not guarantee qualified teachers or quality teaching, but that basic subject knowledge

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is a necessary prerequisite for both. It also cites research showing that student learning in mathematics and science is influenced by the amount of coursework teachers have taken in those subjects as part of their teacher preparation. The report cites one study in which student achievement increased 2 to 4 percent for each additional mathematics course teachers took above the average number of courses taken during teacher preparation (Blank & Langesen, 1997).

The *1993-94 Schools and Staffing Survey: Selected State Results* (Bandeira de Mello & Broughman, 1996) provides state-by-state statistics on college majors of teachers by their teaching assignments. In 1994, Montana was one of eight states in which more than 90 percent of secondary mathematics teachers majored or minored in mathematics. Alaska, Idaho, Oregon, and Washington were among nine states in which fewer than 70 percent of secondary mathematics teachers majored or minored in mathematics. In the area of science, Oregon was one of 12 states in which more than 85 percent of secondary science teachers had a major or minor in that subject.

According to the *Out-of-Field Teaching* report, the proportion of teachers teaching mathematics and science without a minor or major in those subjects is due primarily to a mismatch between those teachers' fields of training and their fields of assignment (Ingersoll & Gruber, 1996). Though current data for all of the states were not available at the time of this printing, some states are implementing licensure changes that may affect the number of teachers teaching outside of their field. In Oregon, for example, students completing fifth-year certification programs for high school mathematics endorsement are now required to have a mathematics major. Further changes in Oregon's licensure system are addressing the issue at the middle school level.

**Table 29**
Mathematics and Science Teachers, Grades 7-12, With a Major in Assigned Field, 1994

| | Main assignment: | | Main or second assignment: | |
|---|---|---|---|---|
| | Math | Science | Math | Science |
| | % with major in math | % with major in science | % with major or minor | % with major or minor |
| Alaska | 50 | 79 | 57 | 76 |
| Idaho | 46 | 77 | 62 | 84 |
| Montana | 77 | 76 | 90 | 78 |
| Oregon | 61 | 93 | 59 | 91 |
| Washington | 49 | 83 | 56 | 84 |
| United States | 72 | 74 | 80 | 78 |

**Source:** *State Indicators of Science and Mathematics Education: 1997*, Council of Chief State School Officers

**Figure 14**
Public School Mathematics Teachers, Grades 7-12, 1993-94

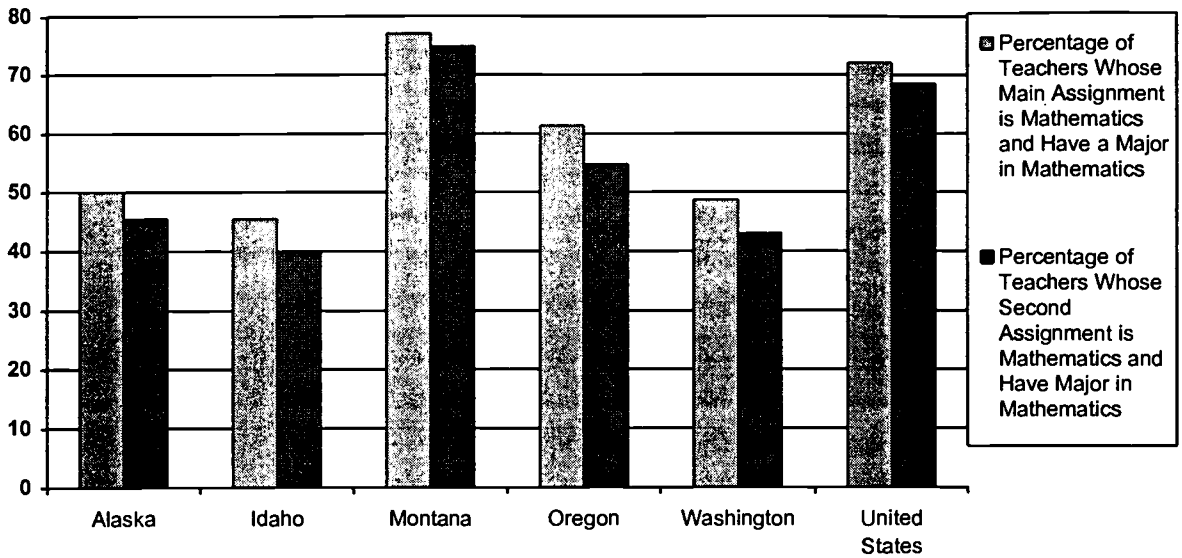
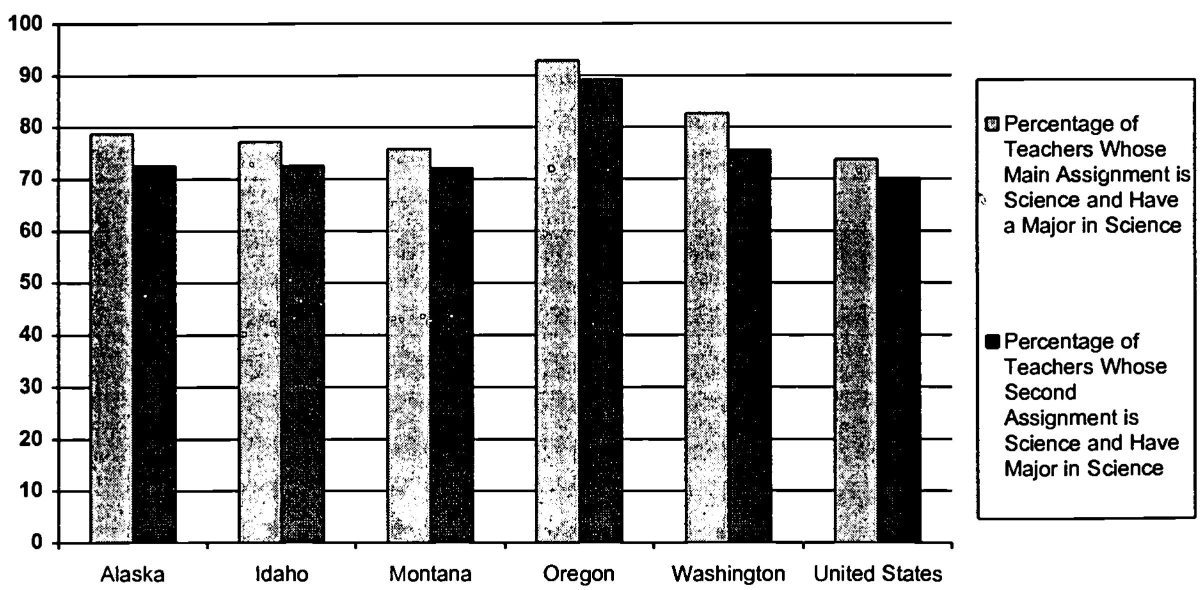



**Figure 15**
Public School Science Teachers, Grade 7-12, 1993-94



## Teachers' Participation in Professional Associations

**National Council of Teachers of Mathematics**—There are about 110,000 NCTM members, and membership is open to any teacher interested in mathematics education. NCTM provides professional development opportunities through annual, regional, and leadership conferences and publishes journals, books, videos, and software. NCTM's World Wide Web site (www.nctm.org) offers information about NCTM programs, publications, and professional development opportunities. Each state branch council also sponsors a publication, educational events for students, and professional opportunities for teachers.

**Table 30**
Mathematics Teacher Associations

| Association | Members | Annual Dues |
|---|---|---|
| National Council of Teachers of Mathematics | 110,000 | $57 |
| Alaska (ACTM) | — | — |
| Idaho (ICTM) | 480 | $15 |
| Montana (MCTM) | 600 | $15 |
| Oregon (OCTM) | 1,750 | $20 |
| Washington (WSMC) | 1,011 | $15 |

**Source:** Individual contact with each professional organization.
— Data not available.

**National Science Teacher Association**—Nationally, there are 53,000 members of the National Science Teachers Association. NSTA publishes five journals, a newspaper, many books, a new children's magazine called *Dragonfly*, and many other publications. The association conducts conventions and provides many programs and services for science educators, including awards, professional development workshops, and educational tours. In addition, NSTA has a World Wide Web site (http://www.nsta.org) with links to state, national, and international science education organizations, an online catalog of publications, and two "discussion rooms" to foster interaction and ongoing conversations about science education.

**Table 31**
Science Teacher Associations

| Association | Members | Annual Dues |
|---|---|---|
| National Science Teachers Association | 53,000 | $60 |
| Alaska (ASTA) | — | — |
| Idaho (ISTA) | 500 | $15 |
| Montana (MSTA) | 600 | $15 |
| Oregon (OSTA) | 730 | $25 |
| Washington (WSTA) | 1,100 | $25 |

**Source:** Individual contact with each professional organization.
— Data not available.

## TEACHER CERTIFICATION AND PLACEMENT

Teacher preparation and certification have a critical effect on mathematics and science education. Teachers play the key role in ensuring that students develop high-level knowledge and skills and achieve challenging standards. Currently, some of the most important issues for teacher preparation include supply and demand for new teachers, equity, and requirements for endorsements in mathematics and science teaching.

Unfortunately, it is difficult to provide a complete picture of teacher certification in the Northwest because the data that states collect and report is not consistent. For example, very little data is available about the number of certificates awarded to minority teachers. Oregon does not report new and renewed certificates separately, so the number of certificates the state issues each year appears very high.

**Table 32**
Number of Teaching Certificates/Licenses Issued by State

| | 92-93 | 93-94 | 94-95 | 95-96 | 96-97 | 97-98 | Teachers Currently Employed |
|---|---|---|---|---|---|---|---|
| Alaska | — | — | — | — | — | — | 7267 |
| Idaho | 7982 | 7371 | 6866 | 7280 | 6126 | 6563 | 12,780 |
| Montana | — | — | — | — | — | — | 10,253 |
| Oregon | 12335 | 11980 | 11524 | 10833 | 11935 | 12690 | 26,757 |
| Washington | 11478 | 12160 | 11514 | 11444 | 12214 | — | 45,345 |

— Data not available.

One of the most pressing issues in teacher preparation is the large turnover in the education workforce expected over the next eight years. By the year 2005, it is anticipated that approximately 28,000 Northwest teachers will reach retirement age or leave the field for other reasons. It is also estimated that over 8,200 new teachers will be needed due to projected enrollment increases (NWREL, 1997).

In the fall of 1998, the nationwide school enrollment hit a record high for the third year in a row. This growth rate is expected to continue for at least eight more years (U.S. Department of Education, 1998). Over the next decade enrollment is expected to grow by 11.1 percent in western states, with Alaska, Idaho, and Washington experiencing the most growth in the Northwest. Alaska is already beginning to experience a shortage of teachers as the 1998-99 school year begins.

The loss of a large number of experienced teachers may be especially significant in mathematics and science education. There is concern that more and more undergraduates with mathematics and science skills are being attracted by other, higher-paying fields, such as technology or engineering.

**Table 33**

New Teacher Demand in the Northwest by 2005

| | Replacements for current teaching positions | | | | Additional teachers needed due to enrollment increases | | |
|---|---|---|---|---|---|---|---|
| | Total teaching force in 1995 | Percent of teachers reaching retirement age by 2005[1] | Percent who plan to leave teaching (93-94)[2] | Total new teachers needed | Percent increase in student enrollment by 2005[3] | additional teachers needed | Total new hires needed by 2005 |
| Alaska | 7,421 | 18% | 4% | 1,603 | 9.3% | 669 | 2,292 |
| Idaho | 12,780 | 18% | 6% | 2,991 | 5.6% | 710 | 3,712 |
| Montana | 10,100 | 19% | 4% | 2,262 | 0.0% | – | 2,262 |
| Oregon | 26,679 | 25% | 5% | 7,817 | 8.6% | 2,254 | 10,112 |
| Washington | 45,345 | 23% | 6% | 12,969 | 10.1% | 4,689 | 17,548 |
| Region | 102,325 | 22% | 5% | 27,641 | 8.3% | 8,284 | 35,926 |
| U.S. | 2,586,487 | 24% | 4% | 726,806 | 4.3% | 111,412 | 838,218 |

Source: *Northwest trends shaping education: The 1997 regional education needs assessment*, NWREL.

[1]Teachers retiring at age 62 and older. Calculated using data from Tables 2.1 and 2.1 *SASS by State—1993-94*, and Table 64, *Digest of Education Statistics 1996*, NCES.

[2]*Table 2.4. SASS by State—1993-94*, NCES. Percent of teachers in 1993-94 who said they plan to leave teaching. This figure is used as a minimum number of teacher leaving the field.

[3]*Projections of Education Statistics to 2006: 25th Ed.*, NCES. Enrollment projections 1997-2005. This projections assumes that class size and other factors affecting teacher demand, such as substituting technology, do not change.

One of the keys to improving mathematics and science education is ensuring that teachers are highly skilled and knowledgeable about the subjects they are teaching. The National Board for Professional Teaching Standards developed rigorous standards for teachers who seek national certification. In the Northwest, all five states have provided support for a limited number of candidates to seek national certification. Currently, there are only 16 nationally certified teachers in the region: one in Idaho, five in Alaska, and 10 in Washington. Alaska has used the National Board's standards as a basis for its own state standards for teachers.

### Alaska

In 1994, Alaska adopted statewide performance standards for teachersand administrators, which were amended in 1997. The standards set guidelines for preparation, licensure, evaluation, and continuing professional development. The standards require that teachers learn and apply knowledge of instruction and assessment, multiculturalism, family and community involvement, learning theory, and professional growth. The standards also require teachers to know the content areas and appropriate instructional practices for the subjects they teach. The Alaska Department of Education and the Professional Licensure Task Force are currently developing a three-tiered licensure system to implement the standards (Alaska Department of Education, 1997).

Alaska imports up to 85 percent of its new educators from outside the state. The state is making efforts to boost the number of teachers hired in-state by tailoring teacher preparation programs to Alaska's standards. In addition, the Rural Educator Preparation Program, a partnership between the University of Alaska and rural school districts, works to prepare and place educators in their home communities.

Alaska Teacher Placement (ATP) at the University of Alaska Fairbanks serves as a clearinghouse for teacher placement in Alaska. The program primarily serves rural school districts and helps place both new and experienced teachers. During the 1996-97 school year, ATP placed 70 mathematics teachers out of 105 registrants and 48 science teachers out of 176 registrants (Alaska Department of Education, 1997).

### Idaho

The Idaho Department of Education publishes an annual report on educator supply and demand in the state. The number of applicants applying for existing positions remained fairly constant until a significant drop in 1997-98. Several science subjects are among the areas with the greatest ratio of applicants per vacancy: earth science (12.6), biological science (8.6), and physical science (8.3) (Idaho Department of Education, 1998).

**Table 34**
Teacher Vacancies by Subject Area

| | Number of vacancies | | | Number of qualified applicants | | | Average no. of applicants/vacancy | | |
|---|---|---|---|---|---|---|---|---|---|
| | 95-96 | 96-97 | 97-98 | 95-96 | 96-97 | 97-98 | 95-96 | 96-97 | 97-98 |
| Elementary | 521 | 476 | 453 | 4412 | 4822 | 4078 | 8.0 | 10.1 | 9.0 |
| Mathematics | 107 | 91 | 74 | 734 | 668 | 414 | 6.0 | 7.3 | 5.6 |
| Biology | 33 | 33 | 36 | 264 | 385 | 311 | 9.0 | 11.5 | 8.6 |
| Earth Science | 23 | 14 | 12 | 215 | 89 | 151 | 13.0 | 6.4 | 12.6 |
| Physical Science | 43 | 28 | 21 | 312 | 255 | 174 | 8.9 | 9.1 | 8.3 |
| Total | 1332 | 1163 | 1054 | 9855 | 10660 | 7955 | | | |

Source: *Educator supply and demand in Idaho*, July 1998, Idaho Department of Education.

To an elementary certificate in Idaho, teachers are required to complete eight semester credit hours in two or more areas of natural science and six semester credit hours in fundamental mathematics. Teachers earning a certificate for secondary teaching have two options. They must can complete preparation in at least two fields of secondary teaching: a major subject of at least 30 credit hours and a minor subject of at least 20 semester credit hours. A second option is completing at least 45 semester credit hours in a single subject area.

### Montana

The Montana Commission on Teaching was established in 1996 as a part of the state's school improvement efforts. The commission is focused on bringing standards for teacher preparation and performance into alignment with standards for student achievement. The commission also elected to implement recommendations from the National Commission on Teaching and America's Future, which include implementing standards for teacher and students; improving teacher preparation, teacher recruitment, and professional development; and encouraging and rewarding teacher knowledge and skill.

In Montana a secondary level teaching certificate, requires that a teacher complete 40 semester credits in their field of specialization. Science is considered a "broadfield" endorsement, which means that teachers must have at least at least 10 semester credits of preparation in each of three science teaching areas. The Montana School Accreditation Standards require that teachers be assigned only in the subject(s) for which their certificates are endorsed.

The Montana Department of Education reports the number of new teacher certificates issued with mathematics and science endorsements.

**Table 35**

Number of New Certificates with Mathematics and Science Endorsements, 1997

| | |
|---|---|
| Mathematics | 71 |
| Science | 125 |

Source: Montana Office of Public Instruction

## Oregon

In Oregon, the Teacher Standards and Practices Commission establishes rules for licensing and adopts standards for teacher preparation programs. In order to receive an initial license, a teacher must pass a skills test in reading, writing, and mathematics. In order to receive an endorsement on an initial license, a teacher must pass a test of their knowledge in the endorsement area.

The initial teaching license in Oregon in a Basic certificate. In order to earn an endorsement on a basic certificate, a teacher must have a major in the field and must have completed a minimum number of semester hours, which vary by endorsement area. The advanced teaching license is the standard certificate. In order to earn an endorsement on a standard certificate, a teacher must have a major in the field and have completed 15 quarter hours of graduate subject matter preparation.

The Oregon Department of Education reports the number of teachers by school level and subject taught as well as the number of new teachers by school level and subject taught.

**Table 36**

All Teachers by Major Assignment and Subject Taught, 1997-98

| | Elementary | Secondary | Other | All |
|---|---|---|---|---|
| Biology | 16 | 293 | | 309 |
| General science | 347 | 340 | 5 | 692 |
| Integrated science | 37 | 149 | | 186 |
| Mathematics | 477 | 1111 | 12 | 1600 |
| Physical science | 11 | 231 | 1 | 243 |

Source: Oregon Department of Education

**Table 37**

New Teachers by Major Assignment and Subject Taught, 1997-98

| | Elementary | Secondary | Other | All |
|---|---|---|---|---|
| Biology | 2 | 13 | | 15 |
| General science | 13 | 22 | | 35 |
| Integrated science | 1 | 7 | | 8 |
| Mathematics | 22 | 46 | 1 | 69 |
| Physical science | | 12 | 1 | 13 |

**Source:** Oregon Department of Education

## Washington

In Washington, teachers who hold endorsed teaching certificates are permitted to teach only in the endorsed subject, and all initial certificates must have subject endorsements. Applicants for continuing certificates must qualify for two endorsements. Teachers may add endorsements by completing the required number of credits in the subject and prescribed essential areas of study (Washington Office of State Superintendent of Public Instruction, 1998a).

**Table 38**

Endorsements on New Certificates, 1996-97

| | |
|---|---|
| Biology | 279 |
| Chemistry | 94 |
| Earth science | 70 |
| Mathematics | 344 |
| Physics | 80 |
| Science | 164 |

Source: *Certificates issued and certified personnel placement statistics, Annual report 1996-97*, Washington Office of State Superintendent of Public Instruction.

The State Board of Education conducted a survey of individuals who completed initial teacher preparation programs in 1995-96 to determine their rate of employment and the numbers employed within their endorsement areas. Teachers who held mathematics endorsements were among the candidates who received the highest percentage of placement within their endorsement area (Washington Office of State Superintendent of Public Instruction, 1998a).

**Table 39**

Employment of New Teachers within Endorsement Areas, 1996-97

| | Endorsements reported | Number employed | Number employed within endorsement | Percent employed within endorsement |
|---|---|---|---|---|
| Biology | 113 | 77 | 39 | 34.51 |
| Chemistry | 44 | 27 | 13 | 29.55 |
| Earth Science | 52 | 27 | 8 | 15.38 |
| Mathematics | 165 | 121 | 101 | 61.21 |
| Physics | 41 | 33 | 13 | 31.71 |
| Science | 70 | 55 | 38 | 54.29 |

Source: *Certificates issued and certified personnel placement statistics, Annual report 1996-97*, Washington Office of State Superintendent of Public Instruction.

## CONCLUSION

Like the rest of the nation, the Northwest is experiencing many changes in the area of education. The population of the region is becoming more ethnically and culturally diverse. New education standards are raising expectations for student achievement as well as teacher expertise. Today's aging workforce of teachers will soon retire, creating a high demand for new, well-trained teachers.

When making decisions about these and other emerging issues, educators and policymakers will want to base their determinations on a combination of information sources. Statistical information can be an important component of the decisionmaking process. Though these data create only a partial view of any issue in education, they can help to clarify trends and issues of importance. We trust that readers will find this statistical overview helpful when quantitative information is required.

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